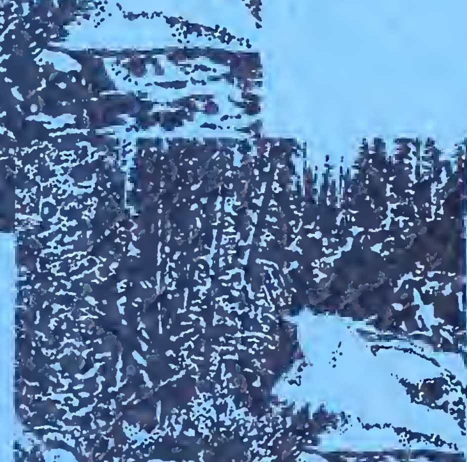
MONTANA WATER QUALITY



1984

MONTANA WATER QUALITY
1984

Prepared by the
Water Quality Bureau
Environmental Sciences Division
Department of Health and Environmental Sciences
Helena, Montana 59620
with assistance from the
Montana Operations Office
and the
Denver Region VIII Office
U.S. Environmental Protection Agency

The 1984 Montana 305(b) Report
October 1984

CONTENTS

SUMMARY

Nature made Montana the benefactor of pure water. A vital resource, its worth continues to increase. The stewardship of this resource remains an important consideration, one which like water itself, becomes more valuable with time.

Maintaining the quality of water for Montanans and neighboring states and provinces requires time, cooperation, knowledge and funding from a broad spectrum of people and organizations.

The job of being good stewards isn't easy. Efforts to protect water quality sometimes are successful, sometimes not. Many times solutions take years. In other instances, problems are uncovered, but no information is available to provide answers. There are also problems waiting to be discovered.

This report provides a review of what has happened in the last two years and gives insights to future plans.

Montana's most pressing water quality problems include:

Streams--Sections of 70 Montana streams have predominantly man-caused problems that could be improved. This accounts for about 1,165 miles of degraded rivers and creeks.

Lakes--A cooperative statewide inventory of 1,000 lakes resulted in the creation of a computerized data base. Thirty lakes were identified for more intensive investigation, which included studying relationships between nutritional status and physical and chemical parameters.

Wetlands--Little progress occurred in identifying the number of wetland acres in Montana. Due to funding shortages, local, state and federal efforts to inventory these areas slowed to nearly a halt. Work continues, but on the basis of convenience, not priority.

Groundwater--Although a great deal of groundwater quality information exists, the data base is not centralized or organized to allow analysis, identification and quantification of pollution problems and trends. Efforts to develop a meaningful information base exist, but are not priority items. Even though there is no major threat to groundwater in Montana, each year reveals more localized groundwater problems. Montana has five sites on the list of 600 national Superfund sites, and two sites not on the list but under CERCLA clean-up authority, with the potential of 79 other Superfund sites.

Special problems include:

1) Eutrophication of Flathead Lake,
2) Saline seep and sodbusting,
3) Riparian zone management,
4) Stream dewatering,
5) Non-point source pollution control,
6) The control of sediment and nutrients from Muddy Creek,

7) The discharge of brackish water from Freezeout Lake through Priest Butte Lakes into the Teton River and
8) The many environmental and social problems associated with toxic algae blooms.

Efforts to control Montana's wide range of water quality problems include:

Monitoring--The state's monitoring program underwent radical changes in the last two years, reflecting rapidly evolving priorities and need for information. Included in the changes were: 1) Suspending the monitoring of biological parameters at the 85 fixed stations, but incorporating such monitoring into other efforts; 2) shifting monitoring priorities from seven U.S. Geological Survey stations to the upper Clark Fork River; 3) concentrating on filling data gaps identified in the 1982 305(b) report; 4) before/after monitoring began on five streams adjacent to municipal wastewater treatment plants scheduled for upgrading; 5) a water release plan concerning discharges of brackish water into the Teton River is being monitored, and 6) a massive monitoring effort began on the lower Clark Fork River to assess the effects of multiple contaminant sources.

Public Water Supply--While the staff of this program doubled in the past few years, the number of regulated public water supplies multiplied six to seven times. Revamping the programs' record-keeping system and streamlining office operations have enabled it to keep up with public demands.

Permits and Enforcement--The Permits Section administers about 400 discharge permits and around 20 groundwater permits. Personnel have been working with the Environmental Protection Agency to implement industrial pretreatment programs in larger Montana municipalities. In the Enforcement Section, public complaints occur at a rate of about 110 to 125 a year, with eight to ten formal enforcement actions each year. Since the inception of the program, the bureau has collected a total of $217,350 in civil penalties, plus $19,638 in agency costs.

Construction Grants--The program's goal of building and upgrading municipal wastewater treatment plants received a severe blow recently when federal participation funds were cut from 75 to 55 percent. Montana's need for facility improvements now exceeds authorized federal funds, but with the increase in local matching money needed to meet the new requirement, efforts to provide adequate local wastewater treatment will be slowed. During the last two years more than 25 major grants were approved to improve local wastewater treatment facilities.

Technical Studies Support--Surface water quality standards are being reviewed and revised, improvements made to water quality data storage systems, studies done on the impacts of lakeshore developments on nutrient loads and the effects of a variety of industrial and municipal developments on water quality.

Water Quality Management--Eight major work programs were carried out in this area. They include: 1) Clark Fork River monitoring, 2)

before/after studies at wastewater treatment plants, 3) Freezeout Lake/Teton River management plan, 4) monitoring water development and diversion activities in the Yellowstone River Basin, 5) preparation of the 1984 305(b) report; 6) creation of a computerized Biological Water Quality Data System, 7) assisting county conservation districts and 8) miscellaneous water quality management activities.

For years the principal goals in Water Quality Management have been "making waters fishable and swimmable by 1983" and the elimination of discharge pollutants by 1985. Although admirable goals, both remain for future accomplishment. In keeping with this continued direction, Montana water quality managers will work to 1) reduce the backlog of identified polluted waters and 2) prevent degradation of high quality waters.

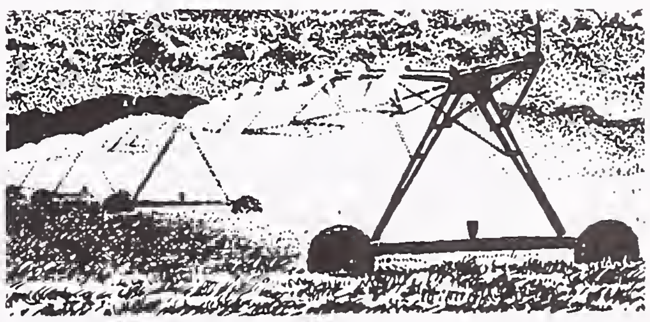
INTRODUCTION

It is with pleasure that I introduce the 1984 report on Montana Water Quality. This biennial assessment of water quality conditions has been prepared by the staff of the Water Quality Bureau and submitted to the Environmental Protection Agency in accordance with Section 305(b) of the Federal Clean Water Act. The previous report, released in 1982, was very well received and may prove to be a difficult act to follow. We continue to add to our knowledge of water quality conditions throughout the state. With the collection of this additional data, each report becomes more complete and objective than the previous document.

This report reflects both success stories of improved water quality conditions and new challenges that must be addressed through our water pollution control program. Our expanded knowledge often brings with it new concerns that must be dealt with. These concerns necessitate the continual adjustment of priorities.

Too often those of us directly involved in the protection of water quality become so engrossed in our daily tasks and duties that we lose sight of the total picture. A report of this nature causes us to pause and reflect not only on what has been accomplished, but also on the direction of future efforts. May this document serve as a useful tool to all persons involved in and concerned with the management of our water resources.

Steven L. Pilcher, Chief
Water Quality Bureau



PROBLEM ASSESSMENT AND PRIORITY WATER BODIES

The purpose of this problem assessment is to direct water quality management activities to where they will be the most effective. This is particularly important today because of the few resources available to correct a large number of pollution problems.

This year's report takes a fresh look at problem stream segments. Besides using the most recent water quality data available, much of it collected in 1983, and evaluating the effects of heavy metals on aquatic life for the first time, the stream assessment includes all streams for which available instream data indicate actual chronic man-caused pollution problems. [In the last (1982) report, only those streams were included that were identified by water quality and resource managers as having possible water quality problems.] Moreover, only those parameters that actually exceeded water quality criteria are listed as problem parameters, as opposed to those that were thought to be problems in 1982. Hence this assessment of problem stream segments is much more complete and objective than the one conducted in 1982.

With the exception of Flathead Lake and Whitefish Lake, Montana's assessment of water quality problems in lakes has not progressed beyond the assessment presented in 1982. An algae bloom of unprecedented proportions occurred in Flathead Lake during the summer of 1983, a symptom of the accelerated eutrophication. Due to mounting scientific evidence that water quality is deteriorating, a large amount of public concern and the establishment of a Flathead Basin Commission by the 1983 Montana Legislature and Governor Ted Schwinden, Flathead Lake and its tributary streams are designated this year as priority water bodies. (See the discussion of Flathead Lake under Special Problems.)

Little more is known about the status of wetlands in 1984 than was known in 1982. They continue to disappear and some, such as Benton Lake and Lake Bowdoin, are becoming progressively salinized. The inventory of Montana wetlands is still incomplete.

The groundwater assessment this year focuses on Superfund and other hazardous waste disposal sites, and on the relatively new and burgeoning problem of leaking underground petroleum product storage tanks. About 47 cases of groundwater contamination from leaking gasoline tanks have been recorded since 1982, and several more from improper disposal of hazardous wastes. Except for the usual procedure of scoring candidate Superfund sites, no attempt has been made to evaluate the relative severity of these problems and to assign a priority for clean-up. Action has been taken in most cases to limit or remedy the contamination from these sources.

The relatively few problems faced by public drinking water supplies are largely natural in origin. Some communities are attempting to remedy their problems by building treatment plants or by switching to other sources. But for communities affected, neither alternate supplies nor the funds for additional treatment are available.

A modified discharge permit issued by the Montana Department of Health and Environmental Sciences' (DHES) Water Quality Bureau (WQB) in April 1984,

allowing the Champion International paper mill near Missoula to release treated wastewater to the Clark Fork River year round, has created a large amount of controversy. People in western Montana, northern Idaho and eastern Washington are worried that the discharges, along with other sources of contamination, will cause irreparable harm to the lower Clark Fork River and Lake Pend Oreille. This concern initiated planning for several hundred thousand dollars worth of water quality studies during the next two years, plus the establishment of a new position in the Governor's office to coordinate water quality management activities throughout the river basin. Hence, the entire Clark Fork River has been designated as a priority water body.

Besides Flathead Lake and the Clark Fork River, Montana's priority water bodies for 1984-85 are those stream segments listed in Table 2 and the lakes listed in Table 4. The problems in Table 2 are largely inherited from a time when strict laws and regulations were not available to protect water quality. Clean-up will be expensive, prohibitive in many cases. With the regulatory tools available today, Flathead Lake, the Clark Fork River and other prized bodies of water can be protected more economically than what it would cost to clean up those already polluted by past exploitation.

Bodies of water may be added to Montana's list of priority waters in two ways. First, a lake or stream may be included in the list if new data verify a problem that could not be verified or was not suspect before. Second, a body of water may be added if there is a substantial threat of pollution from resource development. Since some water quality problems are not amenable to quantitative evaluation (e.g., streambank erosion and sedimentation problems), their absence from the list of priority water bodies will not preclude their eligibility for water quality management programs.

STREAMS

Again the WQB used the severity analysis procedure developed by the Environmental Protection Agency (EPA) Region VIII to assess problem stream segments in Montana. Only this time the entire data base was screened for potential problem segments rather than including just those listed in published reports or known to selected water quality professionals.

In addition to being a more comprehensive assessment of problem streams than the one presented in the 1982 Montana 305(b) Report, the severity analyses in this year's report are more objective. With few exceptions, only those parameters with recorded values exceeding preselected criteria are reported as problems. Probable impaired uses were, in turn, based on which criteria were exceeded.

The severity index values in this report are subject to the same limitations discussed in the 1982 Montana Water Quality Report (see pages 9 and 11). They are intended only as first-order approximations of water quality, and are to be used with circumspection. Because of the somewhat different method used to generate the 1984 severity index values, they cannot be compared directly with values produced in 1982 or with those generated by other states.

Method

The method used to identify and rank apparent and potential problem stream segments in Montana is a variation of the technique developed by the EPA, Region VIII. It is based on the number of times and the degree to which specific water quality criteria are exceeded. If a criterion is exceeded, it is assumed that an existing or potential beneficial use is impaired. If a beneficial use of the water is impaired, then the water is presumed polluted and a problem exists. Implicit in the technique are other assumptions, which are explained below.

The assessment method that the WQB applied to Montana stream segments in 1984 has many steps:

Step 1) A matrix was prepared in which criteria values of individual variables (parameters) were listed for the beneficial uses (Table 1). Values for each criterion reflect Montana conditions and water quality standards. (Fifteen changes to the 1982 matrix were made to better reflect Montana conditions and standards.) It was assumed that each segment is now, or has the potential of being, used for five of the six beneficial uses: warm or cold water aquatic life, drinking water supply, primary contact recreation, irrigation and livestock watering. The livestock watering category might also apply to wildlife watering. It was also presumed that conventional potable water treatment technology generally is not effective for removing or treating all constituents under the public water supply category in the matrix. It should be noted that few problem stream segments are now used for public water supply, even though criteria for this use were applied to all segments;

Step 2) Water quality data for key parameters were collected in 1983 from the 117 potential problem segments identified in the 1982 305(b) report

Table 1. Water quality criteria matrix (milligrams per liter unless otherwise noted). *Beneficial Uses: 1--cold water aquatic life; 2--warm water aquatic life; 3--public water supplies; 4--primary contact recreation; 5--irrigation; 6--livestock watering. **Specific criteria for the protection of aquatic life are based on water hardness.

	*1	*2	*3	*4	*5	*6
Dissolved oxygen	7.0	5.0				
Fecal coliforms (no./100 ml)				200	1000	
Nitrite as N	0.05	0.05	1.0			10.0
Nitrate as N			10.0			
Nitrite and nitrate as N			10.0			100
Total ammonia			0.5			
Un-ionized ammonia	0.03	0.03				
Total inorganic N	1.00	1.00				
Total phosphorus	0.10	0.10		0.10		
Total dissolved solids			500		1200	10000
Conductance (micromhos/cm)					1800	
Turbidity (NTU)	10	50				
Total suspended sediment	30	90				
Chloride			250		700	
Sulfate			250			
Cyanide			0.2			
Magnesium					160	
Sodium					160	
Sodium adsorption ratio					5.0	
Fluoride			2.4		15.0	2.0
Arsenic	0.44	0.44	0.05		0.10	0.20
Barium			1.00			
Boron					0.75	5.00
Chromium VI	0.021	0.021	0.05		1.00	
Iron	1.0	1.0	0.3		20.0	
Manganese			0.05		10.0	
Selenium	0.26	0.26	0.01		0.02	0.05
Mercury	0.004	0.004	0.002			0.010
Temperature (C)	19.4	26.6				
Temperature (F)	67.0	80.0				
Copper	**	**	1.0		5.0	0.5
Lead	**	**	0.05		10.0	0.10
Zinc	**	**	5.0		10.0	25.0
Cadmium	**	**	0.01		0.05	0.05
Chromium III	**	**	17.8			
Nickel	**	**	0.015		2.0	
Silver	**	**	0.05			
pH (minimum)	6.5	6.5	6.5	6.5	4.5	
pH (maximum)	8.5	9.0	8.5	8.5	9.0	

that did not have recent (post-1975) data in the EPA data storage and retrieval system (STORET);

Step 3) Additional water quality data for potential problem stream segments in designated 208 Water Quality Management Planning areas were coded and entered into STORET. (Most of the Montana areawide and Indian 208 information had not been entered into STORET.) Also, all of the data in the Montana water quality data storage and retrieval system as of January 1, 1984, was put into STORET. It was presumed that all water quality information accurately represented instream conditions and met EPA quality assurance guidelines;

Step 4) A request was made to the Data Analysis Branch, EPA Region VIII, Denver, to perform problem severity analyses (using Montana's customized matrix and EPA's computer program and facilities) for all Montana water quality stations having post-1975 data in STORET and for those with 1983 data in STORET. Severity analyses were produced for about 2,700 stations having post-1975 data in STORET and for 240 stations having 1983 data in STORET. A list of monitoring stations used in the severity analyses is available on request from the WQB. Heavy metals were evaluated for aquatic life impairment for the first time in 1984;

Step 5) Among all the segments showing some use impairment, those having predominantly man-caused water quality problems were picked for further evaluation. This selection was based on the nature of the problem parameter(s) and on knowledge of natural background water quality in the same drainage or geographical area. Seventy stream segments totaling 1,165 miles were so selected. One--Daisy Creek in the headwaters of the Stillwater (Upper Yellowstone) River drainage--did not have recent water quality data to substantiate what is thought to be an impairment of one or more beneficial uses;

Step 6) Use impairment values were averaged over all stations considered to be representative of water quality in the reach in question. Then the average use impairment values were totaled to get a severity index value for the reach. This procedure was followed first for stations having 1983 data and then, if no 1983 data were available, for stations with post-1975 data. Included in the severity index value is only one impairment value for aquatic life--either cold water or warm water--depending on the classification of the segment for fish propagation as prescribed by the Montana Surface Water Quality Standards. Streams providing for the marginal propagation of salmonid fish (Class B-2) were considered "cold water" streams;

Step 7) Finally, severity index values for problem segments were qualified with certain non-quantifiable factors that influence and reflect the severity and relative importance of each pollution problem. These are the factors:

a) Downstream use(s) impaired (code letter A)

This factor was applied if one or more uses in the next downstream lake or stream segment were likely impaired due to pollution originating in the problem segment.

b) Improved water quality attainable (code letter B)

This factor was applied if the problem is largely man-caused and manageable under existing regulatory authority and pollution control programs, assuming adequate funding for cleanup is provided.

c) Large population affected (code letter C)

Some problem segments are in Montana's more populous areas where immediate and downstream impacts affect a large share of the state's population.

d) Valued resource affected (code letter D)

In most cases, the criterion for this factor was whether the problem affected a "highest-value fishery resource" as defined by the Montana Department of Fish, Wildlife and Parks (DFWP). This stream classification is similar to the "blue ribbon" classification formerly applied by the DFWP to designate the best quality fishing waters in the state. In other cases, such as the cold temperature of the water in Little Peoples Creek in the Little Rocky Mountains, the factor was applied to waters that are locally unique, although not among the most prized statewide.

e) Interstate, national or international issue (code letter E)

This factor was applied in cases where the pollution problem crosses a state or international boundary or, in the case of Soda Butte Creek in Yellowstone National Park, where a nationally-valued resource is affected.

f) Local interest and involvement (code letter F)

The principal criterion for this factor was whether the local conservation district identified the problem in its water quality plan. Other expressions of local interest also were considered.

g) Unnatural flow fluctuation (code letter G)

Unnatural flow fluctuations can add another element of stress to fish and aquatic life. Excessive withdrawals for irrigation can result in critically high summertime temperatures and concentrated pollutants. The criterion for this factor was whether the problem segment in question has "water removed or fluctuated for agriculture, power, industry, municipal or other" purposes as recorded in the Montana Interagency Stream Fishery Data Base. Information in this category was provided by the DFWP

The method used to generate problem segment severity index values is unique to Montana. These values are intended only as a guide for allocating available resources and for directing water quality management activities within the state. They cannot be compared with other states' values, either to assess relative problem severity or as the basis for allocating water pollution control funds.

Problem Segments

Using the method just described, the WQB identified 70 Montana stream segments having predominantly man-caused water quality problems that could be improved by existing regulatory authority and pollution control programs--funds permitting (Table 2 and Figure 1). These stream segments account for 1,165 miles of degraded rivers and creeks in Montana. Because problems in these streams are predominantly man-caused, they have the greatest potential for improving from pollution control efforts.

A breakdown of pollution sources contributing to these problems (Table 3) indicates their relative importance. Inactive or abandoned mines are a factor in over half of Montana's principal man-caused stream water quality problems. Agricultural practices and municipal wastewater treatment plants are also significant contributors. These sources underscore the importance of corresponding pollution control programs, namely the Superfund and Abandoned Mine Land programs, various agricultural conservation programs, and the Construction Grants and Montana Pollution Discharge Elimination System (MPDES) Permits and Enforcement programs. These and other programs are described in the following section.

Not included in Table 2 are scores of segments totaling thousands of stream miles that are affected by farming, grazing and forestry practices. The "pollutants" in these cases are mostly sediments, salts and elevated temperatures, the last caused in part by dewatering for irrigation. Because these pollutants occur naturally in Montana streams, and because they are not discharged at the end of a pipe, it is often impossible to determine what fraction of a pollution problem is caused by human activities, if any, and what amount of improvement can be expected. Except in cases of extreme nonpoint-source pollution, as in Muddy Creek near Great Falls, pollution control efforts on these streams may have a relatively small chance of succeeding, depending on the level of background or natural pollution.

Several stream segments were removed from the 1982 problem list for these and other reasons. Sage Creek in the Milk River drainage is one of many streams in eastern Montana affected by natural salinity and saline seep. Most prairie streams are frequently turbid and carry large loads of suspended solids. The Big Hole, Jefferson, Bitterroot and other rivers in southwestern Montana are frequently too warm for trout in the summer, due in part to dewatering for irrigation. It is impractical to make these streams cleaner than their natural condition, but even to bring them back to their original quality would require extensive and expensive application of best management practices.

The list in Table 2 includes streams that are threatened by nonpoint source pollution. Plans for accelerated road construction and timber harvest on the ten national forests in Montana will add significantly to the sediment and phosphorus loads of many streams. Placer and hardrock mining activities in headwater areas of western Montana and proposed open pit coal mining in adjacent British Columbia may have similar results. The Montana Department of Natural Resources and Conservation (DNRC) continues to issue permits to divert water from streams that already suffer chronic dewatering. And in eastern Montana, sodbusting and fallow farming threaten to add salts and silt to prairie waterways. The most threatened of these streams, such as the

Table 2. Montana stream segments having predominantly man-caused water quality problems that could be improved by existing regulatory authority and pollution control programs, funds permitting.

Map No. (1)	Stream Segment (2)	Estimated Length (miles)	Basin	Probable Impaired Uses (3)	Pollution Sources (4)	Severity Index (5)	Control Programs (6)
1	Fisher Cr. below Glengary Mine	3	Upper Yellowstone	A(C),P,R,I,L	IM	60.71 B	1
2	Corbin Cr. (tributary of Spring Cr./Prickly Pear Cr.)	3	Missouri-Sun-Smith	A(C),P,R,I,L	IM	47.36 A,B,C,F	1
3	High Ore Cr. below Comet Mine	4	Upper Missouri	A(C),P,I,L	IM,M	47.17 A,B	1,7
4	Bozeman Cr. below Bozeman (2)	1	Upper Missouri	A(C),R	O,U,A,IA	43.42 A,B,F,G	2,5
5	Reese Cr.	8	Upper Missouri	A(C),R	A,IA	39.96 A,B,F,G	2
6	Pipestone Cr.	22	Upper Missouri	A(C),P,R	A,HM,N	39.42 B,F	2,6,7
7	Camp Cr.	25	Upper Missouri	A(C),R,I	A	30.12 B,F,G	2
8	Galena Cr. (Tributary of Dry Fork Belt Cr.)	2	Missouri-Sun-Smith	A(C),P	IM	29.36 A,B,F	1
9	Depot Cr. below Browning WWTP	1	Marias	A(C),P,R	Browning WWTP	28.42, A,B	3,5
10	Mike Horse Cr.	2	Upper Clark Fork	A(C),P,R,I,L	IM	29.35 A,B	1
11	Sand Coulee Cr.	13	Missouri-Sun-Smith	A(C),P,R,I	IM,A	28.18 B,F	1,2
12	Old Maid's Coulee below Cut Bank WWTP	2	Marias	A(C),P,R,I	Cut Bank WWTP,N	25.81 B	3,5
13	Silver Bow Cr. (2)	32	Upper Clark Fork	A(C),P,R,I,L	Butte WWTP,IM,I,U,O	24.30 A,B,C,D,E,F	1,3,4,5,8
14	Cottonwood Cr. (tributary of Sand Coulee Cr.)	7	Missouri-Sun-Smith	A(C),P,R,I	IM,A	19.28 A,B,F	1,2
15	Uncle Sam Gulch below Crystal Mine	3	Upper Missouri	A(C),P,R	IM	18.98 A,B	1
16	Muddy Creek	24	Missouri-Sun-Smith	A(C),P,R	IA,N	18.77 A,B,C,D,F,G	2,6,7
17	Dry Fork Belt Cr.	12	Missouri-Sun-Smith	A(C),P	IM	17.80 A,B,F	1
18	Prickly Pear Cr. below Spring Cr. (2)	35	Missouri-Sun-Smith	A(C),P,R,I,L	IM,I,HM,IA,Helena WWTP, E. Helena WWTP,M,U,G	17.09 A,B,C,D,F,G	1,2,3,5,6,7,8
19	Hyalite Cr. below Forest Service Boundary	20	Upper Missouri	A(C),R	A,IA,O	14.22 A,B,F,G	2,5
20	Soda Butte Cr. below McLaren tailings (2)	4	Upper Yellowstone	A(C),P	IM	12.70 B,D,E	1,5
21	Spring Cr. below Corbin Cr.	2	Missouri-Sun-Smith	A(C),P,R,I,L	IM	12.62 A,B,C,D,F	1
22	Spring Cr. below Ronan (tributary of Crow Cr.)	3	Lower Clark Fork	A(C),R,I	IA,O,U	10.67 A,B,F,G	2,5
23	Fool Hen Cr. (tributary of Virginia Cr.)	2	Missouri-Sun-Smith	A(C),P,L	IM	10.15 A,B	1
24	Cataract Cr. below Eva May Mine	5	Upper Missouri	A(C),P,R	IM	9.60 A,B	1
25	Snowshoe Cr.	5	Kootenai	A(C)	IM	9.32 B	1
26	Belt Cr. below Dry Fork Belt Cr.	60	Missouri-Sun-Smith	A(C),P	IM,A,F,WWTPs,O	8.89 B,F	1,2,3,5

Table 2. Continued

Map No. (1)	Stream Segment (2)	Estimated Length (miles)	Basin	Probable Impaired Uses (3)	Pollution Sources (4)	Severity Index (5)	Control Programs (6)
27	Canyon Cr.	14	Upper Yellowstone	A(C),P,R,I	IA,N	8.82 B,F,G	2
28	Coller Gulch (Judith Mountains)	4	Musselshell	A(C),P,R,L	IM	8.73 A,B	1
29	Montana Gulch (Little Rocky Mountains)	4	Middle Missouri	A(C),P	IM	8.66 A,B	1
30	Willow Cr. below Depot Cr.	20	Marias	A(C),P,R	Browning WWTP	8.26 B	3,5
31	Godfrey Cr.	8	Upper Missouri	A(C),P,R	A,N	6.45 B,F	2,5
32	Beaver Cr. below Lake Bowdoin	40	Milk	A(W),P,R,I	HM,N,A	6.21 B,F,G	7
33	Virginia Cr. below Fool Hen Cr.	6	Missouri-Sun-Smith	A(C),P,L	IM	5.98 B	1
34	Teton R. below Priest Butte Lakes (2)	115	Marias	P,I	IA,HM	5.96 A,B,F,G	7
35	Ashley Cr. below Kalispell WWTP	7	Flathead	A(C),R,P,I	Kalispell WWTP,A	5.95 A,B,C,D,F,G	2,3,4,5
36	Number Five Coulee (tributary of Sand Coulee Cr.)	6	Missouri-Sun-Smith	A(C)	IM,A	5.48 A,B,F	1,2
37	Chicago Gulch (Judith Mountains)	4	Musselshell	A(C),P,R	IM	4.54 A,B,	1
38	Hot Springs Cr. below Hot Springs (2)	6	Lower Clark Fork	A(W),P,R	Hot Springs WWTP,N,G,A	4.48 B,F,G	2,3,5
39	Tenmile Cr.	12	Missouri-Sun-Smith	A(C),P,R	IM	4.22 B,G	1
40	Douglas Cr. at Philipsburg (2)	5	Upper Clark Fork	P,I	IM	3.90 B	1
41	Careless Cr. below Deadman's Canal	8	Musselshell	A(W),P,I	IA,HM,N	3.74 A,B,F,G	7
42	Carpenter Cr. (tributary of Belt Cr.)	4	Missouri-Sun-Smith	A(C),P,R	IM	3.69 A,B,F	1
43	Clark Fork R., Missoula to Frenchtown (2)	10	Lower Clark Fork	A(C),P,R	Missoula WWTP,IM, Milltown Reservoir	3.50 A,B,C,D,E,F	1,3,4,5,8
44	Armells Cr. (Judith Mountains)	5	Middle Missouri	A(C),P,R	IM	3.46 A,B	1
45	Bighorn R. below Yellowtail Dam	70	Middle Yellowstone	A(C),P,R	HM,A,Hardin WWTP,N	3.37 B,G	2,3,5,7
46	Bluewater Cr. below Orchard Canal (2)	3	Upper Yellowstone	A(C)	IA,HM,N	3.25 B,F,G	2,7
47	South Boulder R. below Mammoth	15	Upper Missouri	A(C),P,R	IM,M	3.24 B	1,5
48	Mission Cr.	18	Lower Clark Fork	A(C),P,R,I	IA,A,N	3.07 B,F,G	2
49	Yellowstone R., Laurel to Huntley (2)	30	Upper Yellowstone	A(C),P,R	Billings WWTP, Laurel WWTP, Yegen Drain, IA, I,U,O,N	3.05 B,C,D	2,3,4,5
50	East Gallatin R. (2)	22	Upper Missouri	A(C),P,R	A,O,U,Bozeman WWTP	2.61 B,F,G	2,3,5
51	Clancy Cr.	12	Missouri-Sun-Smith	A(C),P,R	IM,G	2.57 A,B,F	2,7
52	Clark Fork R., Warm Springs to Garrison (2)	37	Upper Clark Fork	A(C),P,R,I	Butte,Anaconda, Warm Springs, and Deer Lodge WWTPs, IM,U,O,IA,I	2.34 A,B,C,D,E, F,G	1,2,3,4,5,8

Table 2. Continued

Map No. (1)	Stream Segment (2)	Estimated Length (miles)	Basin	Probable Impaired Uses (3)	Pollution Sources (4)	Severity Index (5)		Control Programs (6)
53	Post Cr. (tributary of Mission Cr.)	13	Lower Clark Fork	A(C),R,I	IA,A,N	2.31	A,B,F,G	2
54	Elk Cr. (tributary of Blackfoot R.)	12	Upper Clark Fork	A(C)	IM,M,G	2.07	B	2,5
55	Crow Cr.	12	Lower Clark Fork	A(C),R,I	IA, Ronan WWTP,A,N	1.99	B,F,G	2,3,5
56	Dry Fork Marias R. below Conrad WWTP	16	Marias	A(W),P,R	Conrad WWTP,N,A	1.70	B	2,3,5
57	Grasshopper Cr. below Bannack (2)	18	Upper Missouri	A(C)	IM,G	1.66	B,G	1,2
58	Sun R. below Muddy Cr. (2)	18	Missouri-Sun-Smith	A(W),P,R	IA,HM,N	1.48	A,B,C,D,F,G	2,6,7
59	Whitefish R. below Whitefish Lake (2)	19	Flathead	A(C),R	Whitefish WWTP IA,U,O,	1.45	A,B,C,D,F,G	2,3,5,6,7
60	Clark Fork R., Milltown Dam to Missoula (2)	6	Lower Clark Fork	A(C)	A, Milltown Dam, IM	1.42	A,B,C,D,E,F G	1,4,5,8
61	Beaverhead R. below Dillon (2)	35	Upper Missouri	A(C),R	IA, Dillon WWTP, HM	1.41	B,G	2,3,5
62	Silver Cr.	22	Missouri-Sun-Smith	A(C),P	IM,M	1.30	B,G	1,5
63	Lump Gulch Cr.	13	Missouri-Sun-Smith	A(C),P	IM	1.09	A,B,G	7
64	Boulder R. below Basin (2)	45	Upper Missouri	A(C),R	IM, Boulder WWTP, IA,M, A,HM,C,N	1.08	B,G	1,2,3,5,7
65	Stillwater R. below Logan Cr. (2)	31	Flathead	A(C),R	IA,A,F,O,U, Whitefish WWTP	0.96	A,B,C,D,F,G	2,3,5,6,7
66	Little Peoples Cr. (Little Rocky Mountains)	20	Milk	A(C),P.L	IM,G	0.73	B,D	1,2
67	Big Spring Cr. below Lewistown WWTP (2)	17	Middle Missouri	A(C),R	Lewistown WWTP,A,HM	0.61	B,D	2,3,5
68	Clark Fork R., Frenchtown to Huson (2)	10	Lower Clark Fork	A(C),R	Missoula WWTP, Champion	0.56	A,B,C,D,E,F	3,4,5
69	Clark Fork R., Garrison to Milltown Dam (2)	70	Upper Clark Fork	A(C),P,R	Same as #52 plus N,HM	0.47	A,B,C,D,E,F G	1,2,3,4,5,8
70	Daisy Cr. (tributary of Stillwater R.)	3	Upper Yellowstone	?	IM	no post-1975 data		1
		1165						

FOOTNOTES:

(1) Problem segments are mapped in Figure 1.

(2) Impairment of aquatic life in the problem segment has been confirmed by a biologicl survey.

(3) A(C) = Aquatic life (cold water)
A(W) = Aquatic life (warm water)
P = Public Water supply
R = Primary contact recreation
I = Irrigation
L = Livestock watering

(4) A = Agriculture (multiple practices)
C = Construction
F = Forest practices
G = Grazing
HM = Hydrologic modification
I = Industrial discharge
IA = Irrigated agriculture
IM = Inactive mining
M = Mining
N = Natural
O = Onsite domestic waste disposal
U = Urban runoff
WWTP = Wastewater treatment plant

(5) A = Downstream use(s) impaired
B = Improved water quality attainable
C = Large population affected
D = Valued resource affected
E = Interstate, national or international issue
F = Local interest and involvement

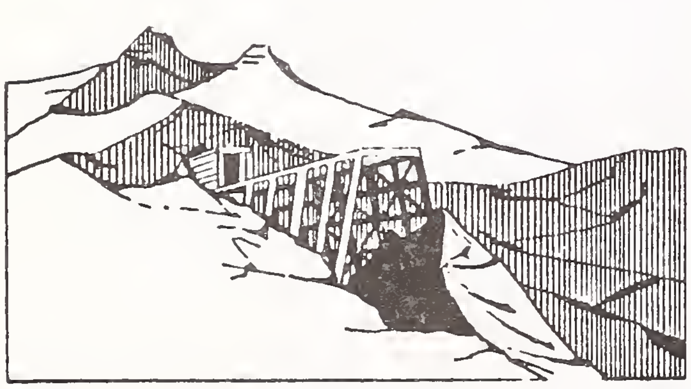
G = Unnatural flow fluctuation

(6) 1 = Abandoned mine land reclamation program (DSL and OSM)
2 = Agricultural conservation programs (SCS, ASCS, CES, DNRC, County Conservation Districts, Ag. Experiment Station)
3 = Construction grants program (DHES and EPA)
4 = Instream flow reservations (DHES and DFWP)
5 = MPDES permits and enforcement program (DHES and EPA)
6 = Renewable resource development program and water development program (DNRC)
7 = Special water quality improvement projects
8 = Superfund

Figure 1. Priority Problem Stream Segments

Table 3. Pollution sources contributing to water quality degradation in problem stream segments in Table 2.

Pollution Source	Number of Segments
Inactive mining	39
Agriculture (multiple practices)	23
Wastewater treatment plants	22
Irrigated agriculture	20
Natural	18
Hydrologic modification (dams, etc.)	12
Onsite domestic waste disposal	10
Urban runoff	10
Grazing	6
Mining	6
Industry	5
Forest practices	2
Construction (highway)	1



North Fork of the Flathead River, should also be considered as priority waterbodies.

Some of the problems on the 1982 list have been mitigated or resolved. The gas and temperature problems in the Kootenai River have been lessened by multi-level withdrawals and increased generation capacity at Libby Dam. The ammonia problem in the East Gallatin River has been eliminated by the installation of advanced wastewater treatment at Bozeman. (The remaining pollution in the East Gallatin River is almost exclusively from nonpoint sources.) An economic analysis of remedies to the Madison River thermal problem below Ennis Lake concluded that none of the alternatives would be cost effective. Sediment control structures have been installed along Bluewater Creek south of Laurel, but follow-up water quality studies have not been done.

Control Efforts

The problems in Table 2 are collectively being addressed by eight programs and program areas that could effect significant water quality improvements. Efforts are at various stages of planning and implementation. These programs and program areas are:

Abandoned Mine Land (AML) Program. Funded by a fee on coal production and administered by the U.S. Office of Surface Mining (OSM) through the Montana Department of State Lands (DSL), the AML program achieves reclamation of inactive mining areas that pose a threat to public health and safety. Thirty-six problem segments in Table 2 stand to be improved by AML projects in Montana, but there has been no implementation for water pollution control to date.

Agricultural Conservation Programs. Included under this rather large umbrella are a number of cost-share, technical assistance, research and educational programs sponsored by the Soil Conservation Service (SCS), Agricultural Stabilization and Conservation Service (ASCS), Cooperative Extension Service (CES), DNRC, county conservation districts and the Montana Agricultural Experiment Station. Important among these are the Agricultural Conservation Program of the ASCS and the Small Watershed and Great Plains Conservation programs of the SCS. In certain areas of eastern Montana, the Triangle Saline Seep Program, a consortium of county conservation districts, may help to alleviate groundwater and surface water salinity problems due in part to fallow farming and excess recharge of rainwater salinized by percolation through salt-laden soils. Thirty-six problems in Table 2 could be improved significantly by implementing agricultural conservation programs and best management practices.

Construction Grants Program. The EPA will share the cost of planning, designing and constructing municipal wastewater treatment systems where upgrading is required to meet minimum treatment standards or where a public health or water quality problem exists. Responsibility for administering this program in Montana has been delegated to the WQB (see Control Programs). Construction grants projects are active on a majority of the 22 problem segments in Table 2 that are affected by municipal wastewater discharges.

Instream Flow Reservations. The 1973 Montana Water Use Act, administered by the DNRC, provides for reservations of instream flows by public agencies for beneficial uses, which include water quality and fish habitat. In 1980, the DHES successfully defended a request for and received a flow reservation in the Yellowstone River for the purpose of maintaining sulfate and salinity at levels suitable for human consumption. The DFWP is preparing to apply for an instream flow reservation in the Clark Fork River, which includes six problem segments that may benefit from guaranteed minimum flows. In addition, the DFWP has purchased water to insure a minimum flow in Ashley Creek near Kalispell.

MPDES Permits and Enforcement Program. The MPDES is administered by the WQB for the purpose of controlling the discharge of pollutants from point sources into state waters. At least 23 of the problem segments in Table 2 are affected by point source discharges, mostly from municipal wastewater treatment plants that are in the process of upgrading their facilities and the quality of their effluents. Where municipal effluents are concerned, the permits program works hand-in-hand with the construction grants program to ensure compliance with permit limits and water quality standards. Enforcement of water quality laws and rules applies to certain nonpoint source activities as well as to permitted and unpermitted discharges.

Renewable Resource Development (RRD) Program/Water Development Program. The RRD program began in 1975 when the legislature voted to use a portion of the state's coal severance tax revenues to protect and develop Montana's renewable resources. The program provides grants and loans to agencies of state or local government for a variety of purposes, including soil and water conservation. The Water Development Program was created by the 1981 Legislature and funded by coal tax revenues to help finance public and private water development projects and activities. Eligible projects include irrigation system repair, saline seep abatement, canal lining, streambank stabilization and erosion control. Both programs are administered by the DNRC. A number of current, special water quality improvement projects on problem segments in Table 2 have been funded by the RRD and Water Development programs.

Special Water Quality Improvement Projects. This is a catchall category of pollution control efforts at the local, problem-specific level. Included are joint WQB/county conservation district planning efforts on Bluewater, Pipestone, Muddy and Prickly Pear creeks, a fisheries mitigation project on High Ore Creek and a brackish water release plan for Priest Butte Lake (both managed by the DFWP), a DNRC hydropower project at Deadman's Storage Reservoir, U.S. Bureau of Reclamation attempts to mitigate a gas supersaturation problem below Yellowtail Dam, and a lake management project for Whitefish Lake. Organized in 1978, the Muddy Creek Special Water Quality Project is one of the oldest local programs in Montana. Some of these local efforts have been funded by the RRD program, 208 and 205(j) water quality management planning grants, and Resource Conservation and Development agencies.

Superfund. The Superfund was set up by Congress and the EPA in 1980 to finance the cleanup of hazardous waste disposal sites that pose a threat to public health. Montana contains numerous existing and candidate sites for Superfund cleanup. Of these, four are located on problem segments in Table

2: 1) the Anaconda Reduction Works at Anaconda, 2) Butte-Silver Bow Creek between Butte and Deer Lodge, 3) Milltown area groundwater near Missoula, and 4) the ASARCO smelter at East Helena. The Silver Bow Creek project has the largest potential to actually improve water quality in Silver Bow Creek and Clark Fork River. Montana's fifth Superfund site is a groundwater problem at Libby. Three additional sites recently have been proposed for inclusion on the national priority list. These are the Burlington Northern tie-treating plant at Somers on Flathead Lake, the Idaho Pole treating plant on Rocky Creek in Bozeman, and the former site of Mouat Industries in Columbus.

A large number of local, state, federal and Indian agencies also carry out water pollution control programs. Notable among these are programs administered by the Montana DSL Reclamation Division, the U.S. Forest Service and Bureau of Land Management, and county soil and water conservation districts. Although these programs may not be singularly important in correcting the problems noted in Table 2, they are extremely important at holding the line against pollution in countless other stream segments.

LAKES

Method

A statewide inventory of lakes* resulted in the creation of a computerized data base. Local fisheries biologists gathered information on more than 1,000 lakes. Geographic data were also obtained for about 500 of these lakes. Field work was performed on more than 30 lakes to obtain more detailed information. The relationships between nutritional status and physical and chemical parameters were investigated for these 30 lakes plus another 30 lakes already having detailed data.

After the information was compiled, data retrieval procedures were developed to list lakes in a variety of ways. These lists include lakes with low or high pH, low dissolved oxygen concentrations, high turbidity, and eutrophic conditions. Based on these factors a list was prepared which contained all lakes which had one or more beneficial uses affected.

There is often no way of judging the severity or cause of the effect on beneficial uses because much of the compiled information is qualitative and incomplete. For example, an unexplained fish kill may have been used as evidence of low dissolved oxygen concentration.

From the list of lakes in which one or more beneficial uses have been impaired, another list was made ranking the lakes by significance. Significance was based on ease of physical access, size [lakes less than 2 hectares (5 acres) surface area were not included], habitat for animals of special concern (rare, threatened or endangered), use as a drinking water supply, local importance and aesthetics. This resulted in a significance rating for 237 lakes.

Problem Lakes

The 20 most significant lakes are listed in Table 4 and mapped in Figure 2. Flathead Lake is not on this list because none of its beneficial uses were affected at the time the lake data base was compiled. However, information gathered since 1982 indicates the lake is undergoing accelerated eutrophication. (See Eutrophication of Flathead Lake in the section on Special Problems.)

Control Efforts

One way to control water pollution in lakes will be to expand and complete the data base. Another way will be to give careful and rigorous review to proposed subdivisions, municipal effluents and industrial developments. Existing rules and laws, such as the Sanitation in Subdivisions Act, will be enforced to insure that lakes are not degraded by domestic wastes.

----

*Horpestad, A. and J. Jarvie. 1983. Montana Lake Inventory: A Report on Activities Funded by a Clean Lakes Grant from the U.S. Environmental Protection Agency, Region 8. Water Quality Bureau, Montana Department of Health and Environmental Sciences, Helena.

Table 4. Twenty most significant lakes with affected uses.

Map Number (Fig. 2)	Lake	County	Significance Rating (1)
1	Ashley Lake	Flathead	36
2	Canyon Ferry Reservoir	Broadwater	37
3	Clark Canyon Reservoir	Beaverhead	37
4	Elk Lake	Beaverhead	34
5	Fort Peck Reservoir	Valley	48
6	Fresno Reservoir	Hill	34
7	Georgetown Lake	Granite	39
8	Holter Lake	Lewis & Clark	38
9	Hungry Horse Reservoir	Flathead	45
10	Lake Elwell	Liberty	37
11	Lake Frances	Pondera	42
12	Lake Koocanusa	Lincoln	38
13	Little Bitterroot Lake	Flathead	44
14	McGregor Lake	Flathead	33
15	Middle Thompson Lake	Lincoln	33
16	Nelson Reservoir	Phillips	36
17	Swan Lake	Lake	45
18	Tally Lake	Flathead	36
19	Upper Red Rock Lake	Beaverhead	36
20	Whitefish Lake	Flathead	45

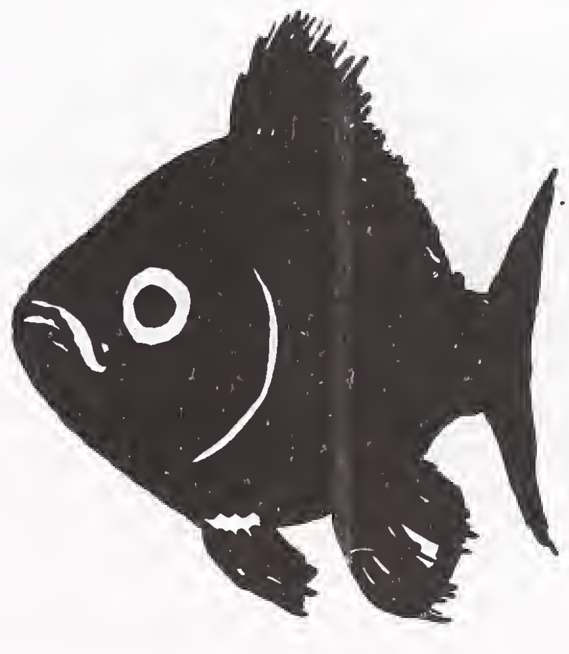
(1) The higher the significance rating the more important is the lake based on the criteria given in the text.

Figure 2. Significant Lakes With Impaired Uses

Residents of the Whitefish area, who are concerned over an apparent decline of water quality in Whitefish Lake, have organized the Whitefish County Water and Sewer District. Whitefish Lake is a significant economic asset to Flathead County and the local community. The lake is situated at the foot of the Big Mountain Winter Sports Area and is popular for boating, swimming, fishing and other water-based recreational pursuits. Expansion of this recreational base is expected along with increased local development and population growth.

A recent study of the limnology of Whitefish Lake* found it to be phosphorus limited and just below the critical threshold for phosphorus loading, above which dense algal blooms could develop. The study found unexpected oxygen saturation deficits in the bottom waters and placed the lake in the oligomesotrophic category. Shoreline creeks were estimated to contribute about 70 percent of the surface phosphous inputs, with bulk precipitation accounting for the remaining 30 percent. Further studies are planned to determine phosphorus inputs from springs and failing septic tank drainfields.

The district is exploring various sources of funding for the purpose of developing a water quality management plan for the Whitefish watershed. Additional studies and monitoring are planned to elucidate phosphorus sources and to document long-term trends in lake water quality.



----

*Golnar, T.F. and J.A. Stanford. 1984. Limnology of Whitefish Lake, Montana. University of Montana Biological Station, East Shore Flathead Lake, Bigfork.

WETLANDS

Wetlands are areas saturated by surface or groundwater long enough to support vegetation typically adapted for life in wet soils, they include swamps, marshes, bogs, sloughs, potholes, wet meadows, river overflows, mud flats and natural ponds.

Montana's wetlands provide habitat for wildlife, particularly migratory waterfowl. They also control floods by retaining water during periods of high runoff and then releasing it gradually. Many groundwater aquifers are fed by wetland recharge. These areas serve as nutrient traps, chemical sinks and sedimentation basins, thereby improving water quality.

The greatest concerns regarding wetland water quality are the haphazard use of pesticides and herbicides and increasing salinity from poor agricultural practices. Livestock watering in wetland areas have been poisoned by the toxic elements and salinity introduced by seeps. Elevated salinity levels in the Benton Lake National Wildlife Refuge near Great Falls have been coincident with an increase in botulism among refuge waterfowl. However, relatively little information is available regarding water quality in Montana wetlands. This is probably because the principal use of wetlands is for wildlife habitat, and the water quality of most Montana wetlands does not impair this use. The actual loss or destruction of wetlands is of greater concern than the impairment of water quality.

The U.S. Fish and Wildlife Service (USFWS) is now conducting a nationwide inventory of wetlands. This inventory will expand a partial survey done in the 1950's. The earlier survey was confined to the 15 northern Montana or "Hi-line" counties and a portion of Lake County.

The earlier study estimated that Montana contained 187,400 acres of wetlands, or approximately two-tenths of one percent of the state's area. The latest National Wetlands Inventory is expected to provide greater detail and a more accurate assessment of the quantity and quality of wetlands in Montana. Maps will be prepared to locate wetlands. The inventory will identify each area according to the USFWS classification system. Only about two percent of the state has been mapped to date. The inventory has not progressed at all since 1982 due to funding limitations.

Without information from the federal inventory it is difficult to assess the status of Montana's wetlands, however it appears they are being lost to development. The actual rate and significance of the losses cannot be measured until the baseline information is gathered.

State and federal agencies will continue to work together to protect Montana wetlands.

The U.S. Army Corps of Engineers administers the Dredge and Fill Permit Program in Montana under Section 404 of the Water Pollution Control Act. This program prevents the wanton destruction and filling of wetland areas. In addition, Executive Order 11990 requires all federal agencies to minimize destruction and loss of wetlands.

The USFWS, in addition to managing several wetland wildlife refuges, also administers a wetlands acquisition program whereby some important and threatened wetlands are acquired by means of easement or direct purchase. In 1982 it was reported that more than 22,000 acres were acquired in 22 Montana counties through this program. Funding, however, has been reduced. Since 1982 four tracts totaling 650 acres have been acquired.

The ASCS of the U.S. Department of Agriculture administers the Water Bank Program whereby private landowners enter into 10-year agreements not to destroy selected wetland areas in return for annual payments. Nine counties (Daniels, Glacier, Lake, Pondera, Sheridan, Toole, Roosevelt, Flathead and Teton) offer or have offered Water Bank Agreements. Approximately 3,000 acres of Montana wetlands have been protected through this program. No new agreements have been signed since 1982, but several have been renewed.

The DFWP manages 45 wildlife management areas. Nineteen of these areas contain wetlands. The DFWP also has been assisting the USFWS with the National Wetlands Inventory, particularly with verification and analysis of wetlands identified in aerial photos.

The Bureau of Land Management (BLM), U. S. Department of The Interior, manages more than eight million acres of land in Montana. The BLM estimates that their land contains approximately 33,000 acres of marshes, wet meadows and seeps, 143,000 acres of riparian areas and 15,600 acres of lakes and ponds. The BLM has filed for water rights on more than 4,300 pothole areas under their jurisdiction in northeastern Montana.

Finally, the Natural Streambed and Land Preservation Act requires permits from local conservation districts for stream construction activities. Unfortunately, these permits do not extend regulatory protection to wetland areas such as marshes, bogs, potholes and ponds.

GROUNDWATER

Identifying and analyzing groundwater pollution is different from doing the same for surface water problems. While a significant amount of groundwater quality information exists, the information is not centralized or organized to allow analysis, identification and quantification of pollution problems and trends.

The Montana Bureau of Mines and Geology is establishing a statewide automated storage and retrieval system for groundwater data. The system, however, is not fully operational. The EPA's STORET is capable of handling groundwater data, but little groundwater information has been entered.

A comprehensive groundwater quality monitoring network has not been developed. Information is generally collected in response to specific problems, making statewide groundwater quality conditions and trends difficult to establish. It is generally believed that there is no major threat to groundwater quality in Montana. However, local groundwater pollution has occurred.

Montana's previous biennial water quality assessment (1982) included discussions regarding groundwater quality and use with respect to saline seep, mining, accidental spills, septic tanks and drainfields, oil and gas exploration activity, solid waste disposal landfills and municipal/industrial wastewater disposal. This assessment will be confined to a description of groundwater quality impacts associated with Superfund, hazardous waste, solid waste management sites and with leaking petroleum storage tanks and delivery systems. Saline seep will be discussed as a special problem.

Superfund/Hazardous Waste/Solid Waste Management Sites

Groundwater contamination has occurred in association with the generation, transport, storage, and disposal of hazardous and non-hazardous wastes.

The DHES, in conjunction with EPA, is currently identifying and assessing waste management and disposal sites in Montana under the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liabiltiy Act (Superfund or CERCLA) and the Montana Hazardous Waste Act (MHWA).

In many instances the DHES is in the early stages of discovering and assessing these sites. The potential for groundwater contamination exists at many sites, but detailed hydrogeological documentation of the contamination is often lacking. Further studies, including additional sampling and monitoring, are required to verify and fully characterize the extent and degree of contamination.

CERCLA provides the authority and funding for emergency response to hazardous material spills and for investigation and cleanup of waste sites already in existence. It requires state participation. The 1983 Montana Legislature passed enabling legislation for the DHES to cooperate with EPA on Superfund projects.

The EPA provides 100 percent of the investigative funds, but the state must pay a share of the corrective costs (10 percent on privately-owned sites and 50 percent on publicly-owned sites) and 100 percent of the operation and maintenance costs.

Every effort is made to require responsible parties to pay corrective costs and, depending on circumstances, they might be required to pay punitive damages up to three times the cost of corrective action.

Site management may be handled either by the EPA or the state. To date, Montana has had the choice on which sites the DHES will assume the lead role.

Of the 600 sites on the national priority list (NPL), five are in Montana. Two more are under CERCLA cleanup authority, although not eligible for Superfund money.

These are the five Montana sites:

Silver Bow Creek (NPL rank 21): Tailings contaminated with arsenic and heavy metals line many miles of Silver Bow Creek and the Clark Fork River, releasing hazardous materials into adjacent surface and groundwater. The DHES has responsibility for site management and received $859,116 from EPA for investigation. A consultant has been selected to prepare detailed work plans, and large-scale field investigations are beginning.

Anaconda Smelter (NPL rank 42): Arsenic and heavy metals from a century of smelting operations contaminate the smelter site and the Opportunity Tailings Ponds. Thousands of tons of flue dust, containing up to 30 percent arsenic, are being uncovered by demolition. EPA is handling the initial phases of investigation at this site, with the cooperation of the Anaconda Minerals Company.

Milltown Reservoir (NPL rank 198): DHES has received $570,000 from EPA to conduct site investigations of the sediments behind the Milltown Dam. The sediment has been contaminated by a buildup of arsenic. This contaminated material subsequently has leached into wells supplying water to 33 Milltown residences. The source, current extent and probable future contamination have been determined. A replacement water supply has been found, and the design for a new water system developed. Replacement is imminent. Further investigations to determine what should be done about the contaminated sediments are underway.

Libby Groundwater (NPL rank 284): Wells in Libby are contaminated with pentachlorophenol and creosote, and appear to be coming from an abandoned disposal pit at the St. Regis lumber mill. The St. Regis Company is funding and conducting remedial investigations under EPA supervision, and also has agreed to take corrective actions.

East Helena Smelter (NPL rank 3 on latest addition of 133): EPA has management responsibility at this site. Studies in the mid-1970s revealed a number of children with elevated blood lead levels. Additional detailed investigations conducted in 1983, indicated that the long-term health hazards have been reduced. Plans have been prepared for more detailed investigations

and ASARCO, the smelter firm, has indicated some interest in conducting parts of these studies.

Rocky Mountain Phosphate, Garrison, and the Anaconda Refinery, Great Falls, are being cleaned up by the owners under supervision by DHES and EPA through CERCLA authority.

The EPA has uncovered another 79 potential CERCLA hazardous waste sites in Montana and there is a possibility of more being identified. These are areas where industrial activities are now, or were in the past, creating toxic material spills or hazardous wastes which could pose a threat to human health or the environment. DHES has received $51,000 from EPA to conduct preliminary evaluations at about half of these sites.

As a result of these evaluations, three additional sites have been proposed for inclusion on the national priority list for further study and remedial action:

Burlington Northern Tie Treating Plant at Somers: Creosote wood preservative wastes have been discharged into a marshy area adjacent to Flathead Lake. Groundwater contamination is suspected.

Idaho Pole Company in Bozeman: Creosote and pentachlorophenol wood preservative wastes have contaminated the shallow groundwater and alluvium of Rocky Creek.

Mouat Industries near Columbus: The plant, which closed in the 1960's, processed chromite ore into sodium dichromate. Waste piles containing sodium chromate and sodium dichromate were left exposed. Hexavalent chromium leached from the waste piles and has been detected in the groundwater.

Additional sites which pose or may be subject to groundwater contamination are:

Arro Oil Refinery, three miles northwest of Lewistown: This approximately 24-acre abandoned oil refinery shows evidence of soil contamination from petroleum wastes. Investigations will be conducted.

Big West Oil near Kevin: Oil and asphalt wastes have been buried in unlined pits. Soils in the area show evidence of contamination from oily wastes. The extent of contamination has not been determined.

Burlington Northern Krezelak ponds east of Havre: Waste oil and diesel sludge were disposed of in former rendering plant lagoons near the Milk River. These lagoons were then covered. An investigation of possible surface water and groundwater contamination will be conducted.

Burlington Northern Mission Wye, six miles east of Livingston: This site served as a historical disposal site for acid sludge. A tar-like material is evident in the soil. Further studies are needed to determine if groundwater contamination occurred.

Burlington Northern Tie Treating Plant at Paradise: Creosote wood preservative wastes have been discharged into an unlined impoundment near the

Clark Fork River. Further studies are necessary to define groundwater impacts.

Carter Oil Refinery, three and one-half miles west of Cut Bank: Refinery sludges disposed of in 35 acres of lagoons might be contaminating groundwater. Additional petroleum industry operations may impact the groundwater in the area.

CENEX/Farmers Union Central Exchange at Laurel: Groundwater quality near a hazardous waste land treatment facility is regularly monitored in accordance with the MHWA. Groundwater contamination from petroleum products in the area of the tank farm is being investigated.

Columbia Falls: Contamination of a shallow domestic well near a wood product waste dump has been reported. Further investigation will determine if monoterpenes have polluted the well.

Comet Oil Re-refinery east of Billings: Waste oil sludge with high levels of lead has been disposed of on site. The site is located a half mile south of the Yellowstone River. Investigations will continue.

Conoco Refinery at Billings: Groundwater quality near closed petroleum waste storage pits is being monitored to determine if contamination has occurred.

Diamond Asphalt, one mile east of Chinook: Oil and asphalt wastes buried in unlined pits could contaminate the groundwater. Further studies are needed to better define potential impacts.

Exxon Refinery at Billings: Groundwater quality near hazardous waste land treatment areas is regularly monitored in accordance with the MHWA. Possible contamination from petroleum wastes in an old flare pit is being investigated.

Falls Chemicals, Inc. in Great Falls: The herbicide 2,4-D is suspected to have contaminated soil and leached into the groundwater adjacent to the Sun River. New wells are to be installed and additional monitoring will be conducted to determine the potential impacts on groundwater.

Hirschy Corrals near Wisdom: A toxaphene dipping solution was disposed of in an evaporation pond. High concentrations of toxaphene have been found in adjacent soil. The potential for groundwater contamination is being investigated.

John Scott Feedlot at Billings: A toxaphene dipping solution was disposed of on the feedlot site. Further studies will be necessary to define any groundwater impacts.

Lohof Gravel Pit, five miles northeast of Billings: Conoco submitted a CERCLA 103 form stating that refinery sludges were disposed of at the Lohof site by contract haulers. Studies to identify possible groundwater contamination will continue.

Miles City Livestock Center: Toxaphene dipping solution wastes were disposed of on the site. High concentrations of toxaphene have been found in the soil. The possibility of groundwater contamination is being investigated.

Montana Pole and Treating Plant at Butte: Pentachlorophenol was discovered seeping down gradient from the plant. Investigations to define the extent of groundwater contamination in the Silver Bow Creek aquifer continue.

Morgan Chemical, six miles west of Great Falls: Residues of pesticides such as hexachlorobenzene, heptachlor, and lindane were washed into a septic tank-drainfield wastewater disposal system. Local groundwater contamination may have occurred. Sampling and investigations continue.

Transbas Inc., on the east edge of Billings: The herbicide 2,4-D has contaminated soil and groundwater at the plant site. A clean-up system has been installed. The success of the cleanup is being monitored.

U.S. Antimony Corporation, 12 miles west of Thompson Falls: Twelve acres of unsealed tailings ponds receive wastewater containing antimony and arsenic, providing the potential for local groundwater contamination. Further studies are necessary to characterize possible groundwater impacts.

Valley Garden Vat, four miles north of Ennis: A toxaphene dipping solution was poured into evaporation ponds where the plastic linings have deteriorated. Further studies are necessary to define possible groundwater impacts.

Included below are brief descriptions of groundwater impacts associated with abandoned mining operations. Contamination of alluvial aquifers with heavy metals, sulfate and acids frequently occurs at these sites:

Basin Mining Area near Boulder: Seepage from mine tailings has contributed heavy metals and acids to the alluvial aquifers of High Ore Creek, Uncle Sam Gulch, Basin Creek and Cataract Creek.

Corbin/Wickes Mining Area, 20 miles south of Helena: Mine tailings and abandoned mine operations have caused local sulfate and heavy metal contamination of groundwater in the Corbin Creek and lower Spring Creek drainages. Cadmium levels have been found to exceed drinking water standards in wells that serve the residents of Corbin. Reclamation activities will be conducted through the AML reclamation program administered by the Department of State Lands. Studies will continue to define groundwater quality problems and public health hazards in the remainder of the drainage.

Hughesville Mining Area near Monarch: Seepage from mine tailings contributes heavy metals and acids to the alluvial aquifer of Galena Creek.

Jardine Mining Area northeast of Gardiner: Mine tailings adjacent to Bear Creek provide the potential for contaminating an alluvial aquifer. A joint mining venture involving Homestake and the Anaconda Company resulted in the recent removal of tailings and revegetation of the area to reduce the pollution potential.

McLaren Mill near Cooke City: Mill tailings along Soda Butte Creek create the potential for contaminating an alluvial aquifer. The Bear Creek Mining Company has relocated the creek away from the tailings, and regraded the tailings to reduce the potential for pollution. It is also suspected that heavy metals and acid are leaching from the McLaren Mine. Tailings at the Glengary Mine, north of Cooke City, also provide the potential for contaminating the alluvial aquifer of Fisher Creek.

Phillipsburg Mining Area: Mercury and heavy metals have been found in alluvial aquifers in several mined areas in the Flint Creek drainage.

Stockett/Sand Coulee Area southeast of Great Falls: Acid mine seeps from abandoned coal mines contribute heavy metals and acids to alluvial aquifers of Sand Coulee and Cottonwood creeks.

Groundwater contamination from solid waste disposal sites can occur as groundwater moves laterally or precipitation percolates vertically through buried wastes. Prior to 1977, solid waste disposal sites and landfills were licensed by counties. In 1977 the Montana Solid Waste Management Bureau was given authority to establish a statewide solid waste site review and licensing system. Before 1967 there were no licensing or review requirements. Landfills established prior to 1967, and to a certain extent prior to state licensing in 1977, are more likely to pose a pollution threat to groundwater.

Prior to the licensing requirements, many communities did not thoroughly consider environmental consequences when siting refuse disposal areas. Landfills were often sited in drainage areas with permeable soils and shallow groundwater. Described below are some of these sites which threaten to contaminate groundwater. Many of these landfills have been closed or are expected to close. Monitoring programs have been developed on a case-by-case basis, and are extremely limited due to high costs. Other disposal sites undoubtedly pose a threat to groundwater quality, but the ones described below appear to pose the greatest pollution hazards:

Alder Dumpsite: High seasonal groundwater exists. No control had been exercised over the disposal of septic tank pumpings or hazardous waste. This dumpsite is expected to be closed.

Anaconda Landfill: The landfill lies adjacent to Warm Springs Creek in an area of high groundwater. The landfill is still in use.

Big Timber Landfill: It is strongly suspected that a leachate plume from the site may be flowing toward the Boulder River. Studies are continuing. The site is expected to close.

Billings Landfill: Monitoring at the landfill site has shown some problem with groundwater contamination. The influence appears to be restricted to an area adjacent to the landfill. Studies are continuing and expanded monitoring is expected.

Butte Landfill: Samples indicate groundwater is being contaminated, but the extent of the problem is unknown. Measures have been taken to minimize the problem. Studies are continuing.

Old Bozeman Landfill Site: The old site is no longer used, but was poorly located in a high groundwater area. There has been some monitoring, which seems to indicate that contaminants are leaching into ground and surface water. Studies are continuing.

New Bozeman Landfill: Monitoring indicates that there is some leaching of contaminants from the site. The contamination appears to be limited to shallow, perched groundwater zones immediately adjacent to the site. Expanded monitoring is being developed and remedial measures are being taken to minimize the infiltration of water into buried wastes.

Cut Bank Landfill: This landfill is located in an area of high groundwater. The extent of contamination is unknown, but continued use of the site is expected.

Helena Landfill: This landfill is situated in moderately permeable soils 30 feet above the groundwater table. It is suspected that a minor leachate plume with high nitrate levels is migrating northward. Studies are continuing.

Missoula Eko-Kompost: This disposal site is actually a resource recovery operation which composts municipal wastewater sludge in Missoula. Pre-existing, unlined lagoons may be leaching nitrates to the Clark Fork River. The lagoons are expected to be replaced with properly designed facilities within the next two years. Monitoring will continue to further assess the extent of contamination.

Red Lodge Landfill: The current landfill site is poorly situated in permeable soils and high groundwater. The site has been ordered closed and will be capped to prevent further infiltration. The landfill is not expected to influence downstream users.

Plains Landfill: This landfill is located in a gravel pit with highly permeable soils. There is evidence that leachate is being formed and a plume is moving toward the Clark Fork River. Remedial efforts to minimize the problem are being implemented.

Scratchgravel Landfill near Helena: The landfill is situated in permeable soils 35 to 60 feet above groundwater. Samples indicate a leachate with high nitrate and conductivity. Studies are continuing.

Sheridan Dumpsite: High seasonal groundwater levels exist at the site. The site is being closed.

Stanford Dumpsite: High groundwater levels exist at the site. A study of alternative refuse disposal options was recently completed. Since the site is near capacity, it is expected to be closed.

West Yellowstone Landfill: This landfill, situated on Forest Service land north of West Yellowstone, has shown indications of groundwater pollution. A plume of leachate containing high total dissolved solids, iron, manganese, lead and carbon dioxide is believed to be moving toward the Madison River. There is no use of groundwater in the area. This landfill has been closed and replaced with a transfer station.

Petroleum Contamination of Groundwater

Petroleum contamination of groundwater is becoming a major problem. It affects near-surface aquifers in virtually every corner of Montana. Several years often elapse after initial leakage and before the pollutant is detected, generally as the result of a domestic water supply being irreversibly contaminated.

At least forty-seven such cases have received DHES assistance since 1982 (Table 5). Petroleum contamination problems have ranged from a few gallons of gasoline leaking into a developed spring to hundreds of thousands of gallons of diesel fuel spread by groundwater flow beneath major railroad centers. Additionally, gasoline storage tanks and delivery lines at service stations are major sources of groundwater contamination.

Petroleum residues may persist in the aquifers for years. Cleanup is expensive and only about 70 percent efficient. Because of the time lag in discovering most problems and the number of potential sources, it is often difficult to identify the responsible party. Litigation likely will be a necessary tool in resolving many of these problems.

It is difficult to budget for petroleum-related contamination because it is impossible to predict the magnitude and number of problems. Large investments in equipment, materials and manpower often are needed to stop and confine the contamination.

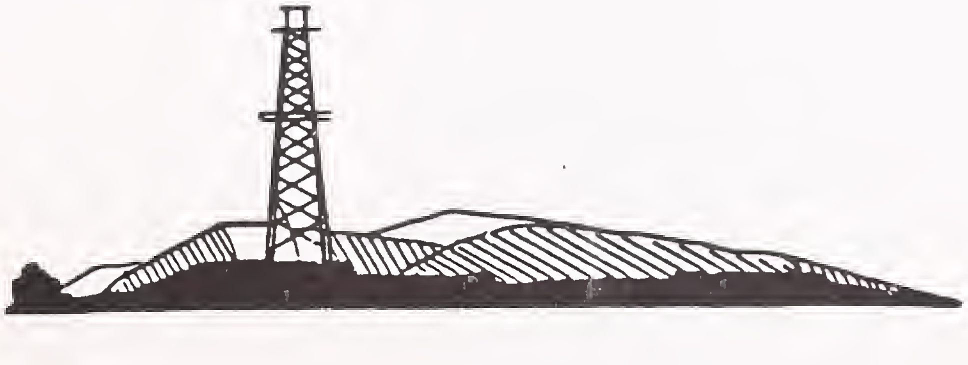


Table 5. Location and type of petroleum-related groundwater pollution problems as of October 24, 1984. (Number in parentheses indicates number of cases in that vicinity.)

Place	Contaminants
Bozeman (2)	Gasoline & Creosote
Sheridan	Gasoline
Darby (2)	Diesel & Gasoline
Dillon	Gasoline
Miles City	Diesel
Augusta	Gasoline
Libby	Pentachlorophenol
White Sulphur Springs	Gasoline
St. Mary	Gasoline
Heart Butte	Gasoline
Kalispell	Gasoline
Polson (3)	Gasoline & Heating Oil (Diesel)
Lewistown	Gasoline
Billings	Diesel
Helena (5)	Diesel & Gasoline
Unionville	Heating Oil
Livingston	Gasoline
Laurel	Gasoline
Plentywood	Diesel
Cut Bank	Diesel
Butte (2)	Pentachlorophenol & Diesel
Lincoln (2)	Gasoline & Waste Oil
Missoula	Gasoline
Reed Point	Solvent
Bigfork	Heating Oil
Somers	Creosote
Paradise	Creosote
Wisdom	Gasoline
Garrison	Gasoline
Havre	Diesel
Lolo Hot Springs	Gasoline
Missoula (3)	Gasoline & Diesel
Bonner (Blackfoot)	Diesel
Judith Gap	Gasoline
Shelby	Diesel

DRINKING WATER SUPPLIES

Groundwater Problems

Groundwater provides water for more than 95 percent of Montana's public water supplies, but these sources serve only about 30 percent of the people who use public systems. Groundwater systems have resulted in few health-related problems. Eighteen community systems exceed the maximum contaminant level (MCL) for fluoride, five, the nitrate MCL, two, the arsenic MCL (one was caused by the buildup of arsenic-laden sediment behind Milltown Dam), and two exceed the MCL for selenium. Of lesser significance are those waters that are safe to drink, but taste and smell bad. Many of the groundwater sources east of the Rocky Mountains have problems associated with one or more of the following: dissolved solids, iron, manganese, hydrogen sulfide gas, sodium and sulfate. In some areas the groundwater quality is so poor, farmers have to haul water or, with the aid of loans and grants, build extensive rural water systems.

Generally, Montana's groundwater is not vulnerable to bacterial contamination. Few sources require chlorination. Two concerns are declining water tables--as in the Glasgow area--and the cross-contamination or mixing of aquifers caused by oil exploration.

Surface Water Problems

Approximately five percent of Montana's public water supplies use surface water. However, these systems provide water to about 70 percent of the people who receive water from public systems. The major concern is that many supplies have no treatment other than chlorination. This leads to violations of the MCL for turbidity and occasionally to serious health problems. Several Montana communities have reported cases of giardiasis, including White Sulphur Springs, Red Lodge and Missoula. Recently Missoula was forced to abandon its Rattlesnake Creek water supply due to an outbreak of giardiasis that was linked to use of the water.

Tastes and odors associated with algae blooms pose problems for many surface water systems. Several communities are seeking to alleviate these problems by building treatment plants or switching to groundwater. Bozeman recently put in a new 10-million-gallon-per-day direct filtration plant. Red Lodge built a new water plant, as have Devon and Fort Peck. Helena has improved and expanded its Missouri River plant, which successfully treated a taste and odor problem in September 1984. Helena is also investigating the use of groundwater and a new treatment facility in the Ten Mile Creek system. Also many non-community supplies have either abandoned their surface sources, replacing them with groundwater sources, or have added filtration and chlorine or ultraviolet disinfection.

SPECIAL PROBLEMS

EUTROPHICATION OF FLATHEAD LAKE

Bodies of water, like people, age. The process of aging is unstoppable and irreversible. Flathead Lake is no exception. It is getting older and changing.

Flathead Lake is the largest natural freshwater lake in the western United States. It supports a large recreational industry and serves as an important local water supply.

During the summer of 1983 there was an unprecedented bloom of algae across the length and breadth of Flathead Lake. Dr. Jack Stanford, director of the University of Montana (UM) Biological Station on the lake, reported "intense bloom conditions...which included large standing crops of several species of algae not previously reported in Flathead Lake." Among those species was the pollution indicator and potentially toxic algae Anabaena flos-aquae, which accounted for an alarming 24 percent of the total standing crop.

To Stanford and others who have been following the fortunes of Flathead Lake over the years, this was a clear sign that the condition of the lake was deteriorating and that something had to be done.

One way scientists judge how fast a lake is aging is to measure the amount of algae it produces from year to year. By this yardstick, Flathead Lake is leaving youth for middle age and is aging rapidly. Although the aging cannot be stopped, a concerted effort can slow the process, improve the condition and lengthen the lifespan of the lake.

One of the many projects completed under the $2.9 million Flathead Basin Environmental Impact Study was a limnological study of Flathead Lake.* The study report established, without a doubt, that phosphorus was the element responsible for recent algae blooms and water quality degradation.

Besides precipitation and dust deposited directly on the lake, the main sources of phosphorus in Flathead Lake are from domestic and municipal wastewater, including household detergents, and particles of soil eroded from the land. The amount of phosphorus entering the lake each year has increased because of the growing population in the basin and the acceleration in disturbing and clearing land of protective vegetation.

To control aging, one must control algae; to control algae, one must control phosphorus; and to control phosphorus, one must treat wastewater and control erosion.

As a blueprint for controlling phosphorus from entering Flathead Lake, the Water Quality Bureau prepared and issued last April a "Strategy for Limiting Phosphorus in Flathead Lake." This report reviews phosphorus

----

* Stanford, J.A., T.J. Stuart and B.K. Ellis. 1983. Limnology of Flathead Lake: Final Report. University of Montana Biological Station, East Shore Flathead Lake, Bigfork.

impacts on the lake, identifies the major sources of phosphorus in the lake, summarizes phosphorus control alternatives and recommends six steps that government agencies, communities and concerned people can take to reduce the amount of phosphorus entering the lake.

Briefly, the six steps are: 1) Impose a 1.0 milligram per liter (mg/1) effluent limit for phosphorus on all MPDES discharge permits in the Flathead Basin; 2) expand the water quality monitoring and evaluation program; 3) recommend legislation to require sale in the area of only low-phosphorus or phosphorus-free detergents (except dishwashing detergents); 4) implement a local nonpoint source program to control phosphorus export from forest activities, agricultural practices, land development and urban runoff; 5) require subdividers to perform phosphorus adsorption tests on soils where drainfields will be placed within 1/2 mile of any surface water, and 6) develop a management plan for non-sewered communities in the Flathead Basin.

The bureau's strategy was unveiled at a public meeting in Kalispell on May 14, 1984. About 200 people attended the meeting and all of those who rose to speak were in support of taking steps to protect Flathead Lake. The most serious reservation about the strategy was whether it would give the lake enough protection.

Beginning with the community of Bigfork, the bureau is now in the process of modifying discharge permits for municipalities in the basin to include the 1.0 mg/1 effluent limit for phosphorus. Permittees will be required to submit compliance schedules based on anticipated completion of advanced wastewater treatment (phosphorus removal) facilities.

The UM Biological Station at Yellow Bay has received a two-year, $100,000 (EPA) grant for research on phosphorus bioavailability and a smaller grant from the WQB for water quality monitoring.

The bureau continues to evaluate mining, timber harvest and other development plans in the basin for their impact on water quality. And the bureau has adopted the policy that if the phosphorus adsorption lifespan of a septic tank drainfield does not exceed 50 years, then advanced (phosphorus removal) treatment must be provided. In support of this policy, the bureau soon will issue guidelines for sanitarians and subdividers on how to calculate the phosphorus adsorption capacity and lifespan of septic tank drainfields.

The remaining tasks in the phosphorus control strategy will require concerted action at the local level. These include controls on the sale of phosphorus detergents, establishing a local nonpoint source pollution control program and preparing management plans for non-sewered communities.

The Flathead Drainage 208 Program was set up initially to accomplish objectives such as these. Indeed, the program at one time sponsored state legislation to control phosphorus detergents and coordinated nonpoint source control activities in the basin. Unfortunately, the Flathead 208 Board is inactive and it has no staff. However, the new Flathead Basin Commission, authorized by the 1983 Legislature, may be the vehicle and catalyst to accomplish at least some of the phosphorus-control goals that require local initiative.

SALINE SEEP AND SODBUSTING

Saline Seep

Summer fallowing in Montana has increased the incidence of saline seep--a condition where wet, salty areas develop in non-irrigated soils, resulting in the reduction or elimination of agricultural crops.

The problem is often caused by precipitation moving through the root zone and into salty substrata when a field lies fallow, resurfacing downslope to form a salt-laden seep.

Saline seep affects water quality by contaminating surface waters and shallow groundwaters, destroying both for use by humans, livestock and wildlife. Currently some rural areas are experiencing degradation of drinking water wells. Many sources of stock water are being abandoned due to salinization. Other beneficial uses are being degraded, such as aquatic life, fisheries and irrigation.

As long as the crop-fallow system is used, water quality will be affected. In 1969, 28 Montana counties reported around 51,200 acres of saline seep. In 1983, the estimated number of acres jumped to 280,000. Left untreated, the acres affected will continue to grow at a rate of 10 percent per year.

In some cases, subsurface drainage has been a successful means of controlling saline seep. But the method is impractical in that applicants have not been able to meet DHES wastewater discharge requirements. The most successful way of controlling saline seep has been the planting of salt tolerant vegetation in the discharge area coupled with intensive cropping or the planting of deep-rooted, perennial vegetation (e.g., alfalfa) in the recharge area.

A program to address saline-seep problems has been created by the Triangle Conservation District and the Northeast Montana Saline Seep Project. The objective is to assist landowners with reclamation and control by delineating problems and preparing on-farm management plans.

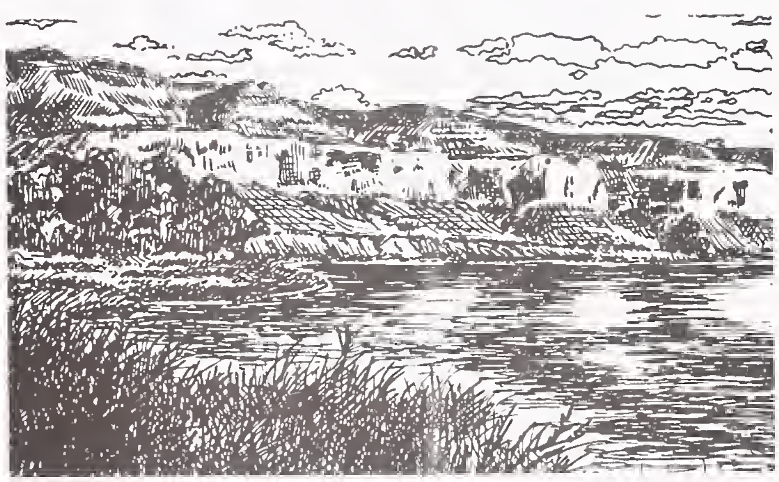
Sodbusting

A new name for one of Montana's oldest environmental problems is sodbusting: the conversion of land suitable for range and pasture to marginal crop land. According to the Soil Conservation Service, 12.7 million acres of range and pasture in Montana are potentially convertible to marginal crop land. From 1977 to 1982, more than 1.8 million acres were converted, or about 300,000 acres a year.

The effects of sodbusting on water quality have not been documented, however removal of native vegetation from grazing land (Classes IV-VIII) does promote saline seep and increases the susceptibility to wind erosion. Both impact water quality: saline seeps contaminate surface and groundwater with salts and wind erosion increases the amount of sediment and nutrients in lakes and streams.

Federal farm legislation often encourages sodbreaking. Other encouragements include the Farmers Home Administration loan policy, Federal Crop Insurance, the PIK program and capital gains realized from the higher valuation of land and crops.

Control efforts in Montana are limited. The Petroleum County Conservation District has passed an ordinance limiting the number of acres that can be plowed without approval from the District. The Lewis and Clark Conservation District has adopted a sediment control ordinance to minimize erosion and sedimentation problems. On the federal level, two sodbreaking bills have been considered by Congress that would restrict federal farm program benefits to those who break up marginal land.



RIPARIAN ZONE MANAGEMENT

Riparian environments are among the most productive terrestrial ecosystems. Management is needed to balance the multiple demands against the need for resource and water quality protection.

The following are the major causes of degradation to Montana's riparian ecosystems:

1) Livestock grazing can affect the riparian environment by reducing vegetation, altering natural stream channels and lowering the water table. The most serious effects on fish habitat are the reduction of shade, cover and terrestrial food supply. Also, disturbing the riparian environment increases the temperature of the water, changes the stream morphology and increases the amount of sediment.

2) Mining can cause pollution by increasing sediment, altering the pH and discharging heavy metals, thereby killing streamside vegetation and causing stream channel and stream flow alterations.

3) Water removed from a river for irrigation or other activities is no longer available for aquatic plants and animals. The riparian ecosystem is also affected by reducing the availability of water to plant species that require a great deal of water.

4) Riparian vegetation is often removed when roads are constructed in floodplains. The result can be a major increase in stream sediment, which can degrade water quality and destroy fish and aquatic life.

5) Riparian zones are highly productive habitats that are normally associated with abundant water supplies, and often the most fertile soil types in the area. Because of these attributes, man has exploited these areas for agricultural and urban development. Removal of riparian vegetation for crops, roads and other development has increased nonpoint-source pollution.

6) Improper logging practices can increase runoff and flooding, which in turn erode streambanks and vegetation. Debris, sediment and nutrients are commonly the result of logging within the stream riparian zone.

The quantity and quality of riparian conditions have not been determined along most streams in Montana. The general consensus is that most of Montana's riparian habitat is in fair condition, however there are areas where conditions could be improved.

Basic efforts to improve riparian ecosystems are limited to existing agricultural programs, with no real emphasis on riparian improvement.

STREAM DEWATERING

Depletion of surface water continues to be a problem along many Montana waterways. Withdrawal of water for irrigation superimposed over natural drought cycles is the greatest culprit. Return flows laden with salt, silt and nutrients are a threat to water quality.

Dewatering occurs regularly on tributaries and along the mainstem of the Bitterroot, West Gallatin, Sun, Milk, Marias, Teton, Musselshell, Little Blackfoot, Boulder and Big Hole rivers and on Prickly Pear Creek. Reservoir storage is often inadequate to counteract the problem perpetuated by unregulated diversions.

The DHES and the DFWP are involved in a variety of projects to improve water quality, fisheries and aquatic habitat. They have developed a water management plan for the Freezeout Lake Wildlife Management Area. (See chapter on Freezeout Lake/Teton River later in this section.) Implementation of this plan will improve water quality for irrigation and aquatic life in the Teton River.

An instream flow reservation and water purchases are being investigated by the DFWP to maintain water quality and protect aquatic habitat in the Bitterroot and upper Clark Fork rivers. The DHES is actively supporting irrigation scheduling and better land management practices in the Yellowstone River, Prickly Pear Creek and Sun River drainages.

In 1980, the DHES and DFWP secured flow reservations in the Yellowstone River to maintain water quality for human consumption and habitat for fish and wildlife. In addition, eight municipalities, fourteen conservation districts, the Bureau of Land Management, Bureau of Reclamation, Montana Department of State Lands and Montana Department of Natural Resources and Conservation were granted consumptive reservations for domestic and agricultural uses.

To date, all municipalities have submitted and received approval for plans to develop their respective reservations. The plans include water conservation, a drought contingency plan and documentation of withdrawals, depletion and return flows. However, projected population increases in seven of the eight municipalities have not materialized, thus only Billings has needed the reserved water. Billings' annual withdrawal is well within its reservation limit, which fulfills projected water requirements through the year 2020.

Potential Yellowstone Basin water projects have been limited by the economic climate. Plans and administrative procedures to develop reserved water have been approved for all agencies. A handful of small projects and provisional permit transfers have been granted, but the demand for water indicated at the time of reservation has not materialized.

Water quality and instream flow reservations have not been affected by water development. Development of reserved water for new projects is expected to continue at a slow pace.

Forest Management

There is concern regarding the U.S. Forest Service's (USFS) watershed management practices in western Montana. Forest watersheds in this area generally have steeper slopes and are more susceptible to erosion than lands in eastern Montana managed by the BLM. Western forests also provide the headwaters for most of Montana's highest quality waters. There are ten national forests in the state that lie within the administrative jurisdiction of the Northern Region (Region One) of the USFS.

Water quality impacts on national forest watersheds occur from such activities as grazing, road building, timber harvesting, oil and gas exploration and production, mining, and small hydropower production. These activities exert a continuing stress on forest watersheds. Water quality degradation occurs during short-term development activities and gradually over a period of time from cumulative impacts from a variety of forest activities.

Several municipalities obtain domestic water from streams in watersheds that are intensely managed for timber production. Special management considerations must be implemented to ensure water quality is preserved.

The natural conditions that restore forest watersheds occur slowly. Development activities in Montana forests continue at an accelerated pace. This maintains pressure on forest watersheds that drives the aquatic system toward instability. The deterioration is slow and not easily detected. Several forests within the region have apparently reached, or are quickly approaching, their maximum timber production capability. In the future, without adequate management, other forest uses will be impaired.

Land management policies which demonstrate an understanding of this situation are necessary to avoid irreversible damage. There is concern that the USFS, in response to a national policy to reduce government spending, has been forced to manage national forest land without adequate resources. Forest Service budgets for watershed protection, which cannot be supported by commodity production, have been sharply reduced.

The budget cutbacks have also reduced water quality monitoring. Monitoring is necessary to assess and document impacts of forest practices. Seasonal watershed technicians and aides have been eliminated in Montana forests, while other watershed staff positions have been eliminated or assigned additional non-watershed duties. There is concern that this will lead to a neglect of watershed problems.

The USFS contributes water quality information to EPA's national water quality data storage and retrieval system, STORET. Only four of Montana's ten national forests, however, utilize STORET. Consequently, a considerable amount of data is often not available for use by other agencies. The Forest Service contends the system is too cumbersome for individual forest hydrologists to enter data into STORET. The DHES recommends that the USFS regional office maintain a staff member to make sure all regional forest water quality information is entered into STORET.

Each national forest maintains a listing or inventory of watershed rehabilitation needs. These are areas in the forests that have experienced erosion problems (such as roads, abandoned mine operations, slump and slide areas and destabilized streambanks) that could be reclaimed. Funding, however, is inadequate. These areas serve as continuing water quality problems, and neglect results in aggravation and expansion.

The Forest Management Planning efforts are not detailed enough to adequately predict water quality impacts. This is particularly true of the long-term, cumulative impacts. Economic models do not assign a value to water quality degradation. The data base for projecting sediment production may be inadequate for all forests. Unroaded lands scheduled for harvest in the next few decades are in the steeper, more sensitive headwater areas. Accessing these lands and harvesting timber will pose significant threats to water quality. There may be a basic conflict in these areas between harvesting timber and preventing degradation of water quality and violation of water quality standards. The possibility of a trade-off between timber yield goals and maintenance of water quality standards exists.

Intermingled land ownership in national forests contributes to watershed deterioration. Three national forests in Montana have significant private lands intermixed with federal holdings. Forests must presently consider managing their checkerboard lands as buffers to reduce watershed damage caused by activities on private lands. As timber supply dwindles on private land, pressure will be placed on the national forests to offer more timber for sale. Some of this timber must come from the areas planned to be used as buffers. Forest supervisors will have to choose between timber product and water quality.

There is a trend in Montana for large, commercial private owners to harvest more timber without worrying about regrowth. Many intend to relocate to the southeastern part of the nation where forest regeneration is more rapid. As this occurs, pressures on the USFS for accelerated timber harvests are anticipated, thus placing more pressure on sensitive, steep roadless areas.

There is concern that the USFS has insufficient resources to monitor contract and permit stipulations. There are questions concerning the implementation of best management practices and assurances that appropriate precautions are being taken to protect water quality at mining operations on forest lands.

In Montana, the Statewide 208 Water Quality Management Plan designates the USFS as the nonpoint source management agency for national forest lands. The WQB and the Forest Service maintain a cooperative agreement for this purpose. The cutbacks in watershed programs are jeopardizing the Forest Service's compliance with the agreement.

The DHES has a particular concern regarding forest practices in the Flathead drainage basin. Flathead Lake is the largest freshwater lake west of the Mississippi. Accelerated phosphorus contributions to the lake are creating great concern. A congressionally authorized $2.9 million Flathead River Basin Environmental Impact Study was recently completed. A permanent Flathead Basin Commission has been established by the Montana Legislature to

oversee development in the basin. More than half of the land in the basin is managed by the USFS. Of this area about 40 percent is non-reserved commercial forest land. This comprises 21 percent of the total land area in the basin. The current Flathead National Forest management plan calls for increases in sediment production on 45 percent of the nonwilderness watersheds. This sediment carries high concentrations of natural phosphorus. The watershed program concerns described earlier carry even greater consequences in the Flathead Basin.

Finally, there is a general concern that watershed program cutbacks have desensitized forest supervisors, district rangers and other forest management personnel to watershed and water quality problems.

Hydrologic Modification

Concern for water quality and aquatic habitat degradation from hydrologic modifications and dredge and fill activities are increasing even though these projects are regulated under the 404 permit program administered by the U.S. Army Corps of Engineers. Degradation associated with individual dredge and fill activities is generally minor, but the cumulative impacts of a number of such projects are significant. The Corps contends it is difficult to pursue enforcement actions against 404 violators because of the difficulty in proving harm from a specific activity in court. It is difficult to demonstrate degradation if the activity occurs in an area where a detailed biological survey has not occurred. As a result, very few enforcement actions are pursued.

Recent regulations direct the Corps to accept and process after-the-fact permit applications from violators in many circumstances. The lack of effective enforcement and the issuance of after-the-fact permits are reducing the effectiveness of the 404 program in protecting water quality and aquatic habitat.

The Corps believes a statutory change to the Clean Water Act is necessary to provide authority for it to issue citations to violators. However, there are possibly other approaches, such as a directive from the Corps' executive administrators directing District Offices to make greater use of enforcement actions. These actions should include administrative cease and desist orders, orders for removal and restoration of the area or any other measures necessary for the protection of the aquatic ecosystem.

There is also concern that some construction operators may not abide by all the conditions set forth in the permits. Few resources exist at the state or federal level to monitor compliance with permit conditions.

Mining

Many of Montana's nonpoint source water quality problems emanate from past mining practices. Seepage from old mine tailings and discharges from abandoned mines cause pollution of streams and rivers. Heavy metals, dissolved solids, sulfates and acid waters are of greatest concern.

Most of Montana's acid mine drainage problems result from past hardrock mining activities. The federal Surface Mining Control and Reclamation Act

(SMCRA) mandates stringent control over coal mining and provides for reclamation of previous mining activities. The AML Reclamation Program is authorized by SMCRA and administered by the Department of the Interior's Office of Surface Mining and the Montana Department of State Lands. It offers significant potential for addressing Montana's acid mine drainage problems. Funds for this program are generated by a fee on coal production.

Section 409(c) of SMCRA requires that AML funds can be used to reclaim hardrock sites only after all of the state's abandoned coal lands have been reclaimed and coal development impacts have been remedied, except for those reclamation projects relating to the protection of public health or safety.

Abandoned hardrock mining operations have caused severe water quality problems in many locations. Water quality standards have been violated and designated uses for growth and propagation of aquatic life have been impaired. Hundreds of stream miles have been so affected.

The federal Office of Surface Mining (OSM) maintains that if people do not utilize these acid mine drainage waters for drinking, there is no threat to public health or safety. The OSM does not recognize aquatic life impairment to be a threat to public health or safety. As a result, much consternation has occurred in obtaining OSM approval for using AML funds to address abandoned hardrock mining problems in Montana.

Agriculture

In Montana, a voluntary nonpoint water quality management program has been established. County soil and water conservation districts are designated the nonpoint source water quality management agencies. The program is intended to encourage the adoption and implementation of best management practices (BMP's). Technical assistance, education, water quality demonstration projects and financial assistance are used to implement BMP's.

The greatest limitation in addressing nonpoint source water quality problems is the lack of funding and, to a certain extent, flexibility in the use of available funds. Any agricultural practice that receives cost-share or technical assistance should have provisions for maintaining water quantity and quality. The Agricultural Conservation Program (ACP) administered by the ASCS, and the Great Plains Conservation Program (GPCP), administered by the SCS, serve as the principal sources of financial assistance available at the federal level to encourage landowner implementation of best management practices. There are also programs such as the SCS Small Watershed Program and Resource Conservation and Development Program and programs administered by the Farmers Home Administration.

These sources of funding do not provide adequate incentive for widespread implementation of water quality conservation practices. The greatest need in Montana is for more money to develop water quality demonstration projects, and to encourage landowners to implement water quality conservation practices. Flexibility in the use of the funding is also necessary to avoid burdensome administrative requirements and inspire more widespread implementation of BMP's.

Irrigation return flows and inefficient use of irrigation water are major causes of water quality problems in Montana. The worst documented erosion problem in the state, Muddy Creek, results from excess irrigation return flows.

A possible solution to these problems would be for federal agricultural agencies to promote efficient irrigation water management systems, and integrate these into cost-share programs. Water management plans should be developed as a requirement for participation in the cost-share programs. The ASCS, SCS and CES are capable of integrating sound engineering construction with efficient water management practices.

Many of the larger irrigation systems in Montana were sponsored by the U.S. Bureau of Reclamation. Many of the canals for these systems are now in poor condition. Seepage exacerbates groundwater and erosion problems. Inefficient irrigation and over-irrigation also aggravate erosion and return-flow pollution problems.

Saline seep often results from conversion of rangeland to dryland cropland. Excess soil moisture accumulates and leaches salts from soils. This reduces productivity and salinizes surface and groundwaters. Alternate crop and fallow field management systems aggravate the problem.

Solutions to saline seep problems center on flexible cropping practices, which use soil moisture efficiently and minimize leaching. The SCS generally promotes and encourages flexible cropping. The ASCS commodity price support programs, however, discourage flexible cropping; they encourage fallow cropland to reduce production. Thus, the SCS and the ASCS work toward opposing goals.

MUDDY CREEK

Muddy Creek, a tributary of the Sun River west of Great Falls, is one of Montana's worst water quality problems. Each year Muddy Creek dumps more than 200,000 tons of sediment and nutrients into the Sun and Missouri rivers, seriously degrading aesthetic values and habitat for fish and aquatic life. This pollution is attributed to stream channel erosion from unused irrigation water and return flows from the Greenfields Irrigation District.

The Muddy Creek Project was organized in 1978 as a joint venture of the Cascade and Teton County Conservation Districts and other resource agencies. A local executive board was created and a project coordinator hired. The coordinator has solicited funds for planning and implementation of pollution control measures, sought technical assistance, informed irrigators in the project area of best management practices, publicized the project and coordinated its day-to-day activities.

Supplemented by local matching money, early planning efforts and administrative costs were funded by an EPA Clean Water Act Section 208 (water quality management planning) grant through the DHES. The Water Quality Bureau has also provided technical assistance by conducting studies on: 1) the amount of nitrate in wells in the Greenfields Irrigation District, 2) the type and amount of nutrients in Muddy Creek and irrigation wastewater drains and 3) the effects of Muddy Creek on the biology of the lower Sun River. Nitrate concentrations exceeding the primary drinking water standard were measured in more than 25 percent of the wells sampled. Sediment generated in the project area was found to decimate aquatic life in the Sun River from the mouth of Muddy Creek to where the Sun River joins the Missouri River at Great Falls.

The approach taken to control water pollution in Muddy Creek and the Sun River has been to implement new irrigation practices on the Greenfields District. With Water Development grants from the DNRC, the project coordinator has been able to provide non-federal cost-share funds to about 10 percent of the irrigators for installing automated, water conserving irrigation systems. A SCS Small Watershed Project will accomplish similar goals in a small portion of the project area.

Despite vigorous and repeated efforts, the Muddy Creek Project coordinator and executive board have been unable to secure sufficient funding for improving Muddy Creek's water quality. Additionally, future funding appears unlikely. DNRC's funding for the coordinator's position has ended, leaving a balance of about $20,000 in cost-share funds for a few more irrigators.

To maintain the momentum, the DHES has agreed to fund the coordinator's position through January 25, 1985 with a Clean Water Act Section 205(j) planning grant. The coordinator will perform the following tasks during the grant period:

1) Coordinate a streambank physical features inventory of Muddy Creek;

2) Assemble available hydrologic and water quality data from the project area and prepare a report that summarizes the findings to date,

identifies data gaps and recounts the history of the project and results obtained;

3) With the assistance of the Montana Bureau of Mines and Geology, prepare a proposal to the EPA for long term monitoring of discharge, water quality and groundwater characteristics in the project area;

4) Continue to seek funding for implementation of water conservation measures on the Greenfields Irrigation District;

5) Use the remaining DNRC Water Development funds to sign up new cooperators, and

6) Work with irrigators to make sure that existing automated systems are functioning as designed.

FREEZEOUT LAKE/TETON RIVER

A corollary to the Muddy Creek problem has been the discharge of brackish water from the Priest Butte Lakes into the Teton River near Choteau. This is one of Montana's worst water quality problems.

Some of the water from the Greenfields Irrigation District is released into the Teton River drainage, specifically into Freezeout Lake and the Teton River by way of the Priest Butte Lakes. In passing through these lakes, the water is naturally salinized.

Freezeout Lake is managed by the DFWP as a waterfowl refuge. Historically there was no natural outlet to the Freezeout/Priest Butte Lakes system. Over the years the water level in the lakes rose, partly because of return flows from the Greenfields project. When the water rose to the point that it threatened public works, an underground outlet was constructed into the Teton River.

Brackish water from the Priest Butte Lakes was released as needed to maintain water levels in the refuge for optimum production of ducks and geese. Little consideration was given to water quality consequences downstream. These releases of polluted water upset downstream water users along the Teton River.

Since 1982 the DHES has been working with the DFWP to develop a water release schedule for Freezeout Lake in order to improve water quality in the Teton River. A draft schedule was sent to refuge staff in January 1984. The schedule is based on the dilution capacity in the Teton River. The objective is to time and measure the release of water from the lakes so that it will have the smallest impact on water quality, aquatic life and irrigation downstream. A maximum specific conductance of about 1,000 micromhos was recommended.

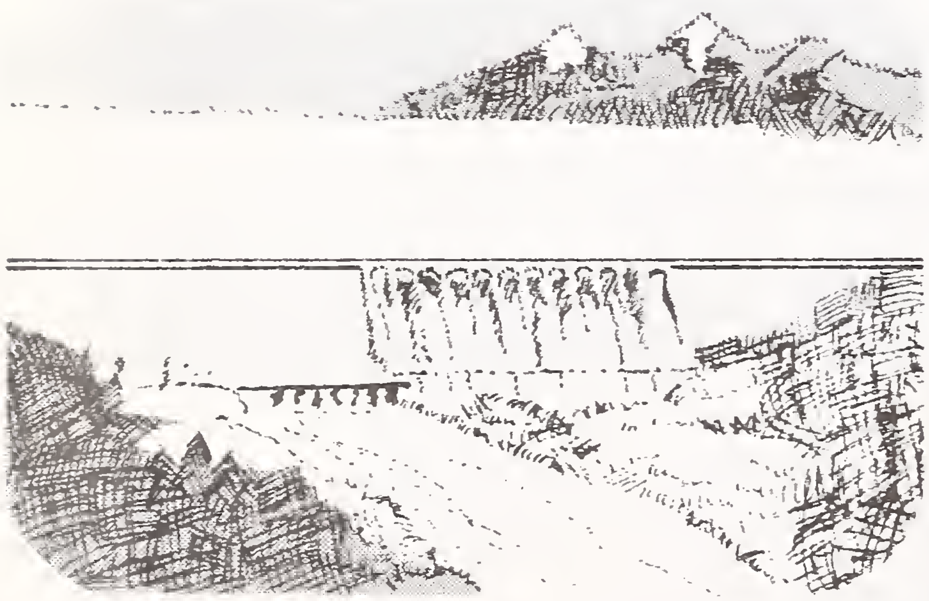
Since adoption of the release schedule by DFWP in early 1984, 10 water quality monitoring runs were performed by WQB between February 7 and September 28 to measure changes in Teton River water quality from above to below the lake discharge, evaluate the effectiveness of the plan and document improved water quality conditions. Also during this time, a staff gauge was installed in the Teton River and calibration of a rating curve begun. The staff gauge and rating curve allowed DFWP personnel to determine the Teton River flow and to meet the required lake water/river water dilution ratios.

During the summer of 1984, drought conditions prevailed over most of Montana and streamflows dwindled. The Teton River below Choteau threatened to go dry. Streamflows as low as 4 cubic feet per second were recorded. despite the lack of water available in the Teton to dilute the increasingly saline lake discharge, DFWP staff did an admirable job of meeting the goals of the release schedule.

Overall, from February through September 1984, the specific conductance of the river at the monitoring station below the lake discharge averaged about 1,150 micromhos, with a range of from 761 to 1,813. Following the first four months of scheduled releases, a more efficient control structure was installed on the lake discharge by DFWP. Also, a simplified version of

the release schedule was provided to refuge personnel. As a result of these refinements, Teton River water quality was maintained at a specific conductance between 761 and 1,139, (average 914 micromhos) from June 1 through the end of the irrigation season.

Under similar conditions of low Teton River streamflow, the WQB has recorded specific conductance values downstream of the lake discharge as high as 3,689. Clearly, improved water quality will result in the Teton River if DFWP will continue to follow the lake discharge guidelines.



TOXIC ALGAE

It was a gorgeous summer afternoon and Canyon Ferry Lake was deserted. Normally one of the most popular recreation areas in Montana for water sports, people were avoiding the lake that day, as they would for many weeks to come. Two weeks earlier, on August 1, 1984, a toxic algae bloom left eight cows, a bull and a calf dead at the water's edge in the shadow of the Spokane Hills.

When most algae bloom they're nothing more than a nuisance. They can foul fishing lines, produce an ugly scum on the surface of a lake or create unpleasant tastes and odors in drinking water. But when blue-green algae bloom, they can do these things and more: they can kill.

Blue-green algae are among the oldest and most primitive of all life on earth. They date from primordial times when most of the plants and animals that we are familiar with were but a twinkling in Mother Nature's eye. Blue-green algae are sometimes called Cyanobacteria, after the bluish pigment (phycocyanin) they produce and their primitive bacteria-like features. But because they are capable of photosynthesis, they are most commonly grouped with the algae rather than with the bacteria.

The prefix "Cyano-" from the word Cyanobacteria has led some laymen to believe that the toxic agent produced by these algae is a form of cyanide. This is not true.

Montana, along with the northern tier of states and the southern fringe of the Canadian provinces, has the doubtful distinction of being included in the Blue-green Algae Belt. Here the hard waters, warm summer temperatures and nutrient-rich soils combine to produce conditions ideal for blue-green algae blooms.

Although blue-green algae are common in Montana's rivers and creeks, only standing bodies of water--lakes, ponds and reservoirs--can produce blooms of the potentially toxic species. The surface water must warm to 68°F or higher before a bloom can occur, which explains why blooms appear only in summer and often begin in shallow bays where there is less water to be heated by the sun.

Some blue-green algae can "fix" molecular or gaseous nitrogen, much as peas and beans do, hence they are less dependent on the ions of this nutrient dissolved in the water. They are also more efficient than other algae at using very small concentrations of phosphorus in water. Bluegreens can form dense surface scums that shade other algae, and they are relatively free from grazing by aquatic animals. Thus the bluegreens have several competitive advantages over other algae.

"Annie", "Fanny", and "Mike" are nicknames for the three potentially toxic species of blue-green algae found in North America and in Montana: *Anabaena flos-aquae*, *Aphanizomenon flos-aquae* and *Microcystis aeruginosa*. All three were present in Canyon Ferry Lake throughout the summer of 1984. Blooms of these algae look like pea soup, green latex paint, chopped hay or grass clippings that someone has dumped into the water.

Fortunately, toxic strains of these algae are rare, but there's no way to predict when and where they will appear. The genetic or environmental factor that triggers toxin production is unknown. Toxic and nontoxic strains can exist side-by-side in the same lake and a toxic strain can appear where a harmless strain or no algae at all existed only a day or two before.

And the toxic algae can disappear just as quickly. Less than a week after the cattle died on the west shore of Canyon Ferry Reservoir, there was no trace remaining of the local waterbloom that killed them.

A common question asked during the Canyon Ferry episode was "How do you tell a toxic strain from a harmless one?" The answer? You don't. Visually they look the same, even under a microscope. The only way to tell for sure is to collect some of the algae and inject a small amount into a laboratory mouse. If the mouse dies, it's toxic; if the mouse is alive after 48 hours, it's probably not toxic.

Wayne W. Carmichael of Wright State University in Dayton, Ohio is a world authority on toxic freshwater blue-green algae. At a 1980 international conference on algal toxins and health, Carmichael summarized what is known about the subject:

> Of about 12 toxins produced by toxic strains of the three potentially-toxic species, only one has been identified and synthesized and its toxicology determined. When waterblooms of toxic strains are present, the cells and toxins can become concentrated enough to cause illness or death in almost any mammal, bird or fish that ingests enough of the toxic cells or extracellular toxin. Major losses of animals include mainly cattle, sheep, hogs, birds (domestic and wild) and fishes while minor losses are reported for dogs, horses, small wild mammals, amphibians and invertebrates. Acute toxicity to humans has not been documented but there is increasing evidence that the toxins cause gastroenteritis and contact irritation.

Three episodes of toxic algae have been documented from Montana: Hebgen Lake (June 1977), Nelson Reservoir (July 1980) and Canyon Ferry Lake (August 1984). All three occurred in years of drought; all three were detected when dead cattle were found in and near water containing a bloom, and all three were caused by the same species of blue-green algae--*Anabaena flos-aquae* or Annie.

Annie produces one of the most deadly of all toxins known to man. Before its molecular structure was determined, scientists simply called it the "very-fast-death factor." The alkaloid toxin produced by certain strains of Annie can kill a laboratory mouse in minutes and full-grown black angus bull in less than an hour. The toxin has a neuromuscular effect: it prevents the nervous system from signaling the muscles to function; the breathing apparatus shuts down and the animal suffocates; a very rigid neck is characteristic at death. Symptoms include staggering, muscle spasms, labored breathing and convulsions. In people who unwittingly ingest the toxin, sensations of numbness, dizziness, tingling and fainting may be manifest. And there is no known antidote.

The other major types of toxin produced by blue-green algae are polypeptides and polysaccharides, which debilitate their victims by breaking down internal tissues. One tell-tale sign in surviving animals is cirrhosis of the liver. Symptoms include nausea, vomiting, severe thirst, diarrhea and lethargy. These toxins have caused outbreaks of gastroenteritis when ingested from municipal drinking water supplies.

The principal source of water for Canyon Ferry Village and the City of Helena is Canyon Ferry Reservoir. Since conventional methods of treating drinking water do not remove or deactivate algal toxins, the raw water used by these communities was tested for low levels of toxin. Samples were sent to Dr. Carmichael in Ohio soon after the toxic bloom was detected. The results were negative. Even if a toxin was present in a waterbloom near Canyon Ferry Dam, where the municipal water is withdrawn, it is unlikely it would get into the water system of either community because blooms are limited to the upper 10 or 20 feet of water whereas the communities draw their water from a depth of 80 feet at the dam.

Several people living around Canyon Ferry take their water directly from the lake or from nearby wells. The DHES does not condone the consumption of untreated water from surface supplies. But if the water intake in the lake is deep enough, it will escape the most concentrated part of the waterbloom near the lake surface. A deep and properly constructed well back away from the shoreline also will afford some protection.

There have been no human deaths reported from toxic waterblooms. This is not because people aren't susceptible, but because most people simply would not think of drinking water directly from a bloom. Does this mean that blooms are safe to swim in? Not necessarily.

First, you can't tell just by looking at it whether a bloom is toxic. And nearly everyone from time to time will inadvertently gulp some water while swimming. Children, who are more susceptible because of their low body weight, are even more prone to take on some extra water while swimming or playing at the beach.

When people come in contact with a waterbloom, chemicals produced by Cyanobacteria can cause allergic responses such as rashes and hayfeverlike symptoms. These responses may vary in intensity from person to person, just as people may be more or less sensitive to certain kinds of pollen. In animals, ingestion of water containing blue-green algae pigments can make exposed or light-colored skin much more sensitive to sunlight, causing blisters and peeling.

Blue-green algae toxins are not known to concentrate in fish. Even fish that have been killed by blue-green toxins probably have not been exposed long enough to accumulate a lethal dose for humans. Vigorous fish caught on hook and line should be safe to eat, although they may taste "weedy" if taken in or near a waterbloom.

As waterblooms break apart, the decomposing algae will not generate much oxygen through photosynthesis and the process of bacterial decomposition will take considerable oxygen out of the water. Even in a healthy condition, algae in a massive waterbloom will respire enormous amounts of oxygen at

night. This can create a localized depletion of dissolved oxygen, which may be just as deadly as algal toxins to fish and aquatic life.

So far in Montana we've been fortunate. No deaths have occurred and no cases of serious illness due to toxic algae have been confirmed.

Concerning the Canyon Ferry bloom this summer, we owe our good fortune to Dr. Bradford Newcomb, the veterinarian who diagnosed the cause of the cattle kill, to the prompt notice and frequent monitoring provided by the DHES, to the mouse bioassays run by the Department of Livestock Veterinary Diagnostic Lab in Bozeman, to the careful posting of the shoreline by the DFWP and to all of those who heeded the warnings and avoided the waterbloom.

What caused the 1984 Canyon Ferry waterbloom? Blame it on the weather; the same unusually hot, still, dry and sunny weather through July and August that wilted dryland grain crops and turned Montana forestland into a tinderbox. Surface water temperatures exceeded 73^{o}F in Canyon Ferry Reservoir last summer, which was more than warm enough to trigger a bloom. When the wind blew, it came out of the southeast, concentrating the algae along the west shore of the reservoir.

Canyon Ferry was not alone last summer. Dense waterblooms were reported on Clark Canyon Reservoir near Dillon, Hebgen Lake near West Yellowstone, Homestake Lake near Butte, Lake Elmo near Billings, Ackley Lake near Lewistown, Whitetail Reservoir near Boulder and Willow Creek Reservoir near Harrison. Fortunately, none of these other waterblooms were toxic.

Long-time residents around Canyon Ferry claim that waterblooms are nothing new and that the '84 bloom was no bigger than some. Research conducted by Professor John Wright, now retired from the MSU Biology Department, bears this out.

In September 1956, only one year after Canyon Ferry was filled, Wright found that blue-green algae accounted for over half the volume of all algae in the reservoir. Two potentially toxic species--Fanny and Mike--were present in 1956.

In 1971 and 1972 Ron Rada, a student of Dr. Wright and now a professor at the University of Wisconsin in LaCrosse, found blue-green blooms in July, August and September of both years. Annie, Fanny and Mike all were present. Rada reported that blue-green algae became abundant when the water temperature at the surface reached 63^{o}F and that blooms developed when the temperature approached 68^{o}F. (Remember, surface water temperatures exceeded 73^{o}F in Canyon Ferry last summer.)

Some people point to nutrients from agricultural and municipal sources upstream from Canyon Ferry Reservoir as a factor in the '84 bloom. Thanks to improved agricultural practices and sewage treatment, these sources are probably smaller now than in the past. However, runoff into Canyon Ferry during July 1984 was the fourth highest July inflow of record. Since nutrient loads in rivers are largest during runoff, the unusually high flow in the Missouri River could have been another factor contributing to the Canyon Ferry bloom.

Reservoirs like Canyon Ferry tend to produce more algae in the first few years after they are filled. Natural lakes, on the other hand, produce more and more algae as they get older. This is basically because nutrients are trapped in lakes with surface outlets and not in reservoirs with deep-water outlets. Since reservoirs are net exporters of nutrients, they tend to become less productive as the years go by until algae production levels off. As Rada explained in his Ph.D. dissertation:

> Canyon Ferry could be classified as a moderately productive or slightly eutrophic reservoir. There was no evidence to indicate that the reservoir had become more eutrophic from 1957-1958 to 1971-1972. In fact, it appeared to have become less eutrophic. Canyon Ferry Reservoir lost its high initial level of productivity and appeared to be approaching a lower steady state level of production by 1971-1972. This level of production should continue throughout much of the life of the reservoir.

Does this mean it won't happen again in Canyon Ferry? Given the same weather, the bloom could be just as thick and just as toxic next summer. Toxic blooms are rare, but they're probably not as rare as we think they are. Three cases have been confirmed in Montana only because livestock happened to be watering at the exact location and at the precise instant of a toxic waterbloom. How many others have gone undetected? Perhaps dozens, even hundreds.

The waterbloom on Canyon Ferry has dissipated. A shoreline inspection on October 11 failed to uncover any trace of the bloom. Surface water temperature was down to 55^{o}F and the DHES has given the "all clear" for the remainder of 1984.

Waterblooms are a fact of life in Montana. They can occur anywhere and at any time from May through October. Heavy concentrations of blue-green algae should be presumed toxic until proven otherwise. People should avoid waterblooms and keep children, pets and livestock away. This is good advice at any lake in Montana, not just at Canyon Ferry.

For more information about toxic waterblooms, write the Water Quality Bureau, Montana Department of Health and Environmental Sciences, Room A206, Cogswell Building, Helena, Montana 59620. The Department also will provide free analyses of waterblooms for the presence of potentially toxic algae.

CONTROL PROGRAMS

MONITORING

The purpose of monitoring is to provide information for water quality management. Water quality monitoring is the first and last line of defense against pollution. Monitoring is required for a number of purposes, among them setting stream classifications, establishing and enforcing water quality standards, detecting trends, determining wastewater treatment requirements, allocating waste loads, evaluating pollution impairment of beneficial uses, arranging problems in order of priority for cleanup action and assessing the water quality improvements realized from cleanup action.

This section deals with ambient, instream monitoring performed by the Water Quality Management Section of the WQB. Monitoring in response to complaints and to check compliance with limits set for permitted discharges (compliance monitoring) is discussed under Permits and Enforcement. Monitoring of public water supplies is discussed under Public Water Supply. Self-monitoring of municipal and industrial effluents is not discussed here.

Montana's monitoring program has undergone radical changes since 1982, reflecting rapidly evolving priorities and needs for water quality information: 1) Monitoring of biological parameters has been suspended indefinitely at the 85 fixed stations in the Montana Biological Monitoring Network, but biological parameters have been incorporated into most other bureau monitoring efforts; 2) the collection of chemical oxygen demand (COD) and total suspended sediment (TSS) data at seven water quality stations operated by the U.S. Geological Survey has been dropped in favor of a much more intensive monitoring effort on the upper Clark Fork River; 3) a major effort was made in the spring of 1983 to fill data gaps on potential problem stream segments identified in the 1982 305(b) report; 4) before and after studies were begun on five streams receiving wastewater from municipal treatment plants scheduled for upgrading; 5) monitoring began on the Teton River to ascertain the effectiveness of a Freezeout Lake water release plan designed by the WQB and being implemented by the DFWP; 6) an extensive quarter-million-dollar monitoring project was initiated on the lower Clark Fork River to assess the effects of multiple contaminant sources and to evaluate the consequences of year-round discharge by the Champion International paper mill near Missoula, and 7) several small intensive surveys have been and will be conducted as needed (e.g., Bridger Creek, Stoner Creek and Lake Creek).

Quality assurance and data management are two critical components of the WQB's ambient monitoring program. Efforts in these areas continue much as described in the 1982 305(b) report. All water quality monitoring performed by the Bureau conforms to EPA quality assurance guidelines, and all data so generated are incorporated into the bureau's data management system and entered periodically into EPA's STORET. In addition, bureau personnel are working to develop a computerized data storage and retrieval system for biological data to interface with the existing system for chemical and physical data.

The following sections describe monitoring underway on the lower Clark Fork River and summarize results of monitoring completed on the upper Clark

Fork River and in the East Gallatin River below the Bozeman wastewater treatment plant. The results of monitoring completed in the Teton River below the outlet from Priest Butte Lake are summarized under Special Problems--Freezeout Lake/Teton River. For more information on the lower Clark Fork River monitoring project, the reader is referred to the project plan dated April 1984, which is available on request from the WQB.

Lower Clark Fork River

The largest water quality monitoring project ever conducted by the WQB began March 1984 on the lower Clark Fork River. The quarter-million-dollar, two-year effort will attempt to determine whether contaminants from various wastewater sources along the river are affecting beneficial uses of the river.

The project was prompted by a groundswell of public concern over the condition of the river and shortage of water quality data with which to make management decisions.

Beginning at Turah, above Milltown Reservoir, and extending for 225 miles downstream to below Cabinet Gorge Dam in Idaho, the monitoring network includes 31 fixed water quality stations on the river, in its four mainstem reservoirs and along the three major tributaries--the Blackfoot, Bitterroot and Flathead rivers. The bureau also will monitor conditions in a number of deep pools and slow-water areas between the Champion International paper mill at Frenchtown and the Thompson Falls Reservoir at Thompson Falls. Sampling will be done monthly and more frequently during the spring high water season.

A variety of chemical, physical and biological water quality variables will be measured in several hundred samples collected from both shallow waters and from the bottoms of deepwater pools and reservoirs. In addition to the scheduled sampling, field personnel will look for and record any incidental evidence of water quality degredation.

The two largest dischargers to the lower Clark Fork River--the City of Missoula Wastewater Treatment Plant and the Champion International Paper Mill at Frenchtown--have been asked to expand their self-monitoring programs to provide data needed by the state to assess water quality impacts. Much of the recent concern over the river's health stems from a controversial decision by the DHES to approve a modified discharge permit to the Champion Mill. The modified permit, issued in early April of 1984, allows Champion to increase its yearly load of suspended solids to the river and to discharge year-round, but only when flows in the river exceed 1,900 cubic feet per second (cfs). (Before, Champion could not discharge below a river flow of 4,000 cfs, which limited discharges to a brief period in the spring.)

Nutrients, heavy metals and suspended solids, especially organic solids, will be scrutinized closely. Champion and the City of Missoula are the two largest point sources of nitrogen and phosphorus, which may be stimulating undesirable algal growth in downstream reservoirs and in Lake Pend Oreille in Idaho. The heavy metals originate far upstream in the Butte Mining District, but there is evidence they have been dispersed throughout the floodplain downriver to Milltown Dam, and perhaps even below that point. There is concern that respiration of the organic solids released by Missoula and

Champion may cause deficits in dissolved oxygen downstream, and also lower the pH of bottom waters, which may in turn mobilize metals and make them more toxic to fish and aquatic life.

Additional studies conducted by DHES on the river in 1984 were a diurnal dissolved oxygen study at 12 sites, a dye study to determine time of flow between stations and a diurnal chemical analysis of the Missoula wastewater treatment plant effluent. DHES is also contracting with the University of Montana to measure phosphorus, organic matter and metals in bottom sediments from mainstem reservoirs, and to conduct a benthic river metabolism study using Plexiglas enclosures. Additionally, DHES has petitioned the EPA to conduct a chronic fish bioassay on the Champion effluent and to perform a series of algal assays on water from various reaches of the river in Montana.

Joining the bureau in studies during the next two years will be the DFWP, the State of Idaho Division of Environment, the U.S. Geological Survey, Champion International and researchers from the University of Montana. Relevant data from the various studies will be used by the DHES to write an environmental impact statement prior to consideration of the reissuance of the Champion discharge permit in April 1986.

Champion also will be investigating various alternatives to its present use of rapid-infiltration ponds for wastewater disposal. The ponds, which worked well for several years, are becoming plugged. This plugging resulted in a greater reliance on direct discharge of treated wastewater, hence the need for a modified discharge permit.

Meanwhile, a large number of studies are underway on Silver Bow Creek and the upper Clark Fork River, many of them associated with the Silver Bow Creek Superfund project. The bureau also monitors water quality at seven stations on these two streams, which are perhaps the most abused and studied waters in Montana. All of the Clark Fork River studies in Montana are being coordinated by a position in the Governor's Office which has been funded in part by a grant from the Anaconda Minerals Company. Other sources of funding include the EPA, the Montana Water Resources Research Center, Champion International, and state general funds for water pollution control.

To put the DHES' Clark Fork monitoring in perspective, bureau field crews will collect and carry over the next two years, an average of one gallon per day of Clark Fork River water over McDonald Pass to the DHES Chemistry Lab in Helena. Not only will this be one of the largest water quality monitoring projects in state history, it will also amount to a significant interbasin transfer of water, and one of the few to cross the Continental Divide.

Upper Clark Fork River

Silver Bow Creek and the upper Clark Fork River are Montana's water pollution horror stories of yesteryear. These streams were long abused by mining, industrial and municipal wastes from the Butte/Anaconda area. Although the upper Clark Fork has recently been on the mend, thanks to improved wastewater treatment, its quality still fails to meet criteria designed to protect public water supplies, fish and aquatic life and other actual or potential beneficial uses.

Multiple pollution sources in the upper Clark Fork River drainage, some of them very difficult to control, continue to plague the river with dissolved salts, metals and nutrients. Because the Anaconda Minerals Company suspended operations in Butte in 1983 and the Berkeley Pit is filling with water, because of pending cleanup action by the Superfund and AML programs, because the company still holds an MPDES permit for wastewater discharged from the Warm Springs settling ponds, and because of questions concerning the integrity of these ponds, the WQB feels it is more important now than ever before to monitor the quality of this river system. Many years worth of hard-won water quality improvements easily could be lost without continued vigilance.

The WQB is collecting water quality data at seven stations on Silver Bow Creek and the upper Clark Fork River.

The Clark Fork River station at Deer Lodge is the principal ambient water quality station on the river and the only comprehensive long-term water quality station in Montana operated exclusively by the state. Parameters include discharge, total suspended solids and turbidity, lab pH/alkalinity, hardness, field pH and temperature, specific conductance, common ions, algal nutrients and selected metals (Arsenic, Cadmium, Copper, Iron, Manganese, Lead and Zinc--total recoverable). Samples were collected sporadically from 1974 to 1977 and monthly since 1978.

The following five stations have been sampled monthly since December 1982: Clark Fork River above the Little Blackfoot River, Clark Fork River below Warm Springs Creek, Anaconda Company Warm Springs Pond No. 2 discharge, Warm Springs Creek at the mouth and Mill-Willow Creek Bypass at the mouth. Parameters include turbidity, temperature and pH, specific conductance, sulfate, Cadmium, Copper and Zinc (total recoverable).

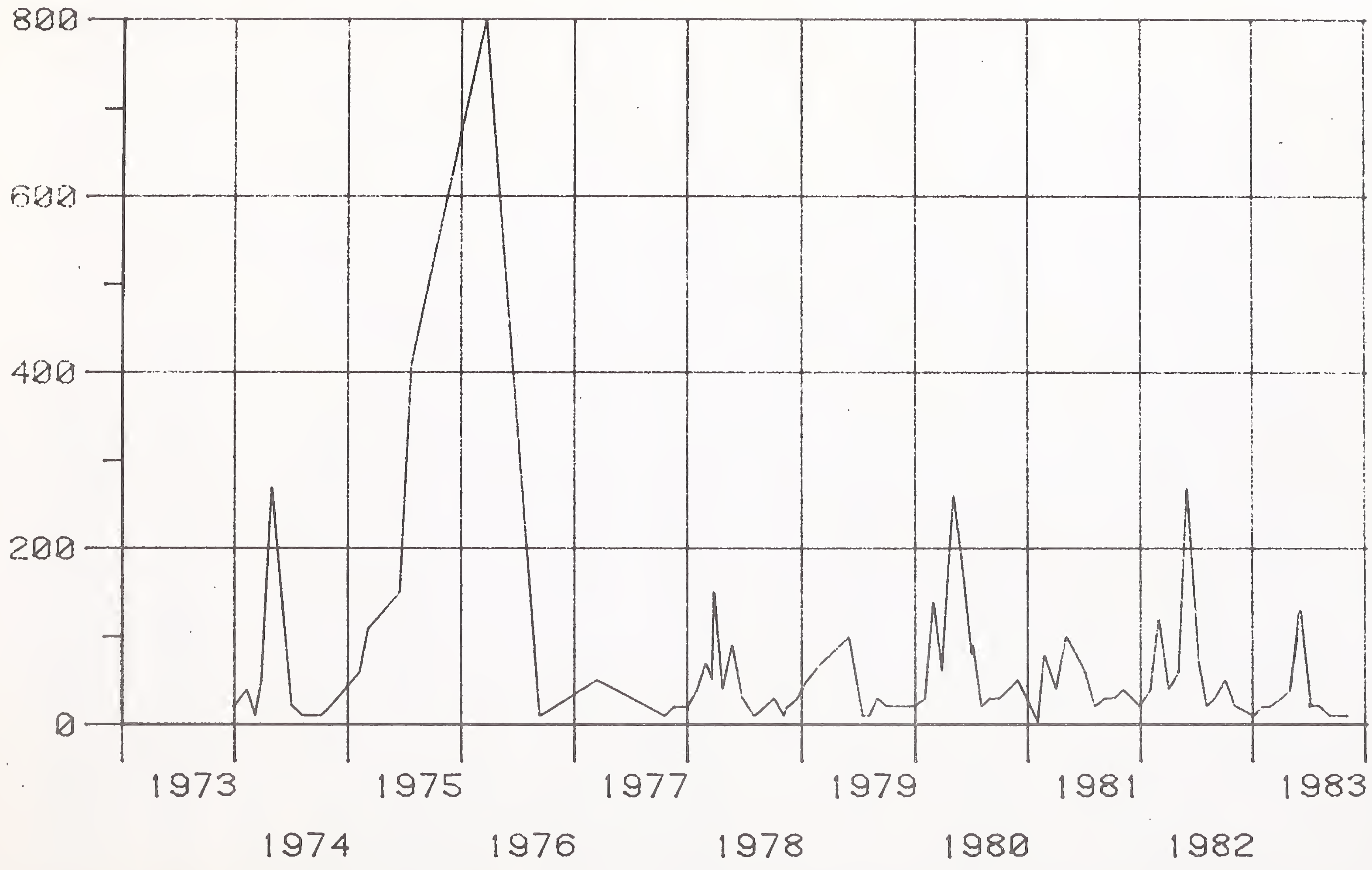
Silver Bow Creek at the Frontage Road above the Anaconda Company Warm Springs Ponds has been sampled monthly since January 1984 for the same parameters as the five stations previously mentioned.

The purpose of this monitoring has been to 1) monitor the Anaconda Company MPDES discharge from Warm Springs Pond No. 2, 2) assess the seasonal contributions of water quality contaminants from various sources and the effectiveness of the Warm Springs Ponds treatment system, 3) measure any water quality changes resulting from the shutdown of the Anaconda operations or Superfund/AML activities and 4) evaluate water quality in the two "C" reaches of the upper Clark Fork River (C-2 from Warm Springs Creek to Cottonwood Creek and C-1 from Cottonwood Creek to the Little Blackfoot River). With successful reclamation in the area, there is a chance that these two reaches, as well as Silver Bow Creek itself, may be upgraded in classification.

The data from these stations are entered into the DHES water quality data storage and retrieval system and transferred quarterly into STORET.

Plots of data collected over the last ten years at the Deer Lodge station have been prepared to ascertain trends, if any, in water quality contaminants. The plot for copper (Figure 3) shows seasonal pulses in concentration associated with spring snowmelt runoff. Plots for other

Figure 3. Total copper (ug/1) in the Clark Fork River at Deer Lodge, 1973-1983.



metals, e.g., zinc and iron, show similar peaks. The size of these spring peaks appears to be a function of the magnitude of the snowmelt runoff and the amount of suspended sediment carried by the river. Silver Bow Creek is bypassed around the Warm Springs Ponds during runoff.

The plot for sulfate (Figure 4) shows a generally decreasing trend in concentration. The secondary drinking water standard for sulfate is 250 mg/l, a level that has not been exceeded since 1981.

As sulfate decreased, so did hardness (Figure 5). But as hardness decreases, the toxicity of heavy metals such as copper increases. Hence there must be an equivalent reduction in the concentration of copper and other toxic metals in order to maintain the same level of protection for fish and aquatic life.

Perhaps the most telling evidence of the recovery in Silver Bow Creek and the upper Clark Fork River is in the aquatic biology. Through a contractor, the Anaconda Minerals Company has been collecting benthic macroinvertebrate data at several stations on both streams every fall since 1972, when the company initiated major improvements in their wastewater treatment and handling program. Since 1972 there has been a steady improvement in macroinvertebrate diversity and a parallel, though less dramatic increase, in macroinvertebrate density in the upper Clark Fork River (Figure 6). Some biological recovery has also occurred in Silver Bow Creek, although it has not progressed to the extent that it has in the river.

Continued monitoring in Silver Bow Creek and the upper Clark Fork River will record any changes in water quality resulting from pollution control and resource development activities.

East Gallatin River

The East Gallatin River through Bozeman is rated by the Montana DFWP as a "high priority fishery resource." Because of chronic point and nonpoint source pollution problems, this reach of river has been classified B-2 (marginal propagation of salmonid fishes and associated aquatic life) in the Montana Surface Water Quality Standards. These problems and the potential value of the fishery prompted the DHES to designate the East Gallatin River as a priority water body for water quality improvement.

Under primary, and then partial-secondary treatment, the Bozeman wastewater treatment plant for many years produced unacceptably large concentrations of toxic ammonia, organic solids, algal nutrients and residual chlorine, which poisoned fish and aquatic life, reduced levels of dissolved oxygen and stimulated nuisance growths of algae in the East Gallatin River downstream from the outfall. The 1975 Water Quality Inventory and Management Plan for the Upper Missouri River Basin recommended upgrading the Bozeman wastewater treatment plant to improve water quality in the river. Late in 1982 the City of Bozeman began operating its new advanced-secondary treatment plant, which greatly improved the quality of the discharge.

In 1983 the WQB conducted a follow-up study to ascertain instream improvements in water quality achieved by upgrading the Bozeman wastewater treatment plant. Seasonal measurements were made of physical and chemical

Figure 4. Total sulfate (mg/l) in the Clark Fork River at Deer Lodge, 1973-1983.

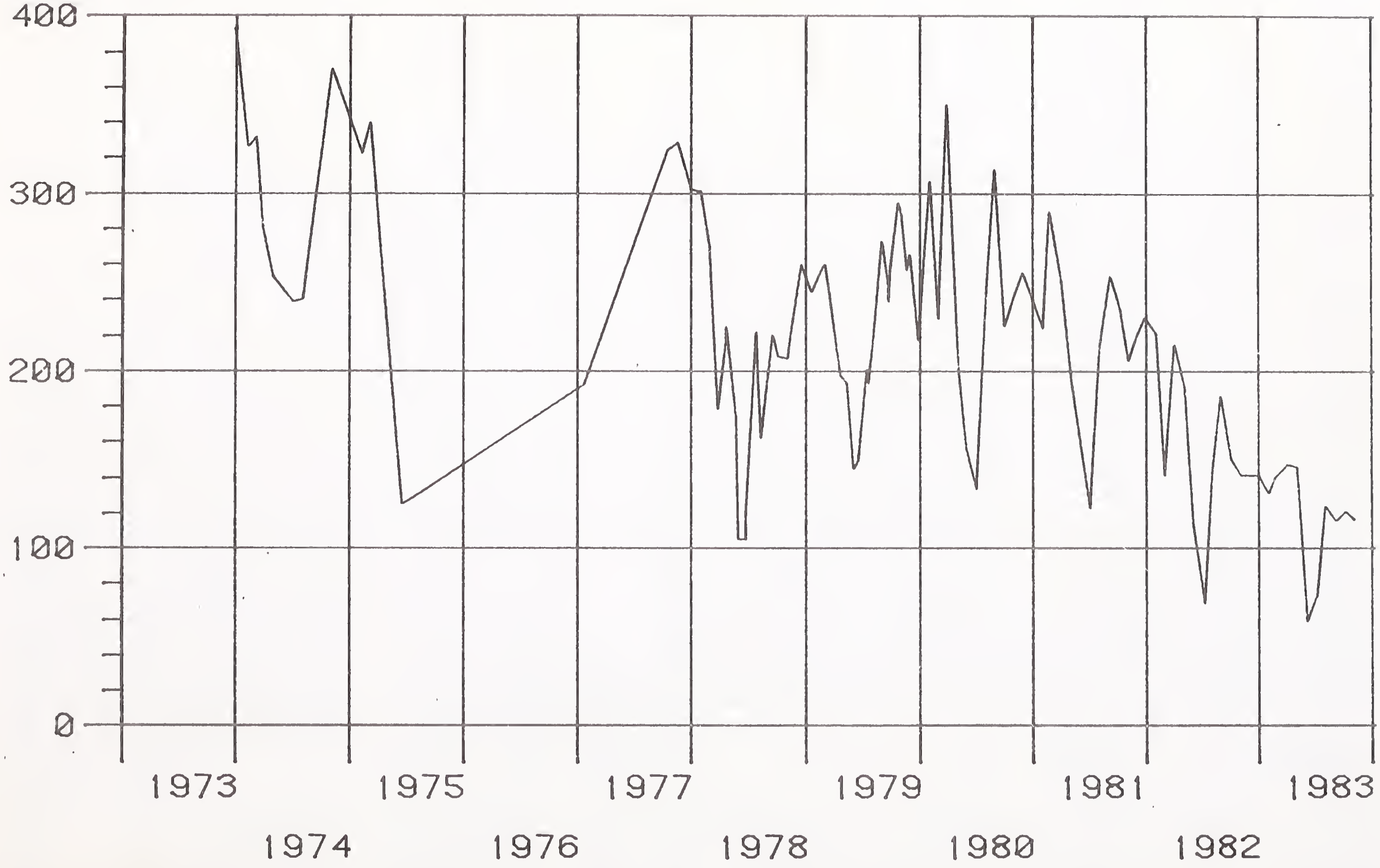


Figure 5. Total hardness (mg/l) in the Clark Fork River at Deer Lodge, 1973-1983.

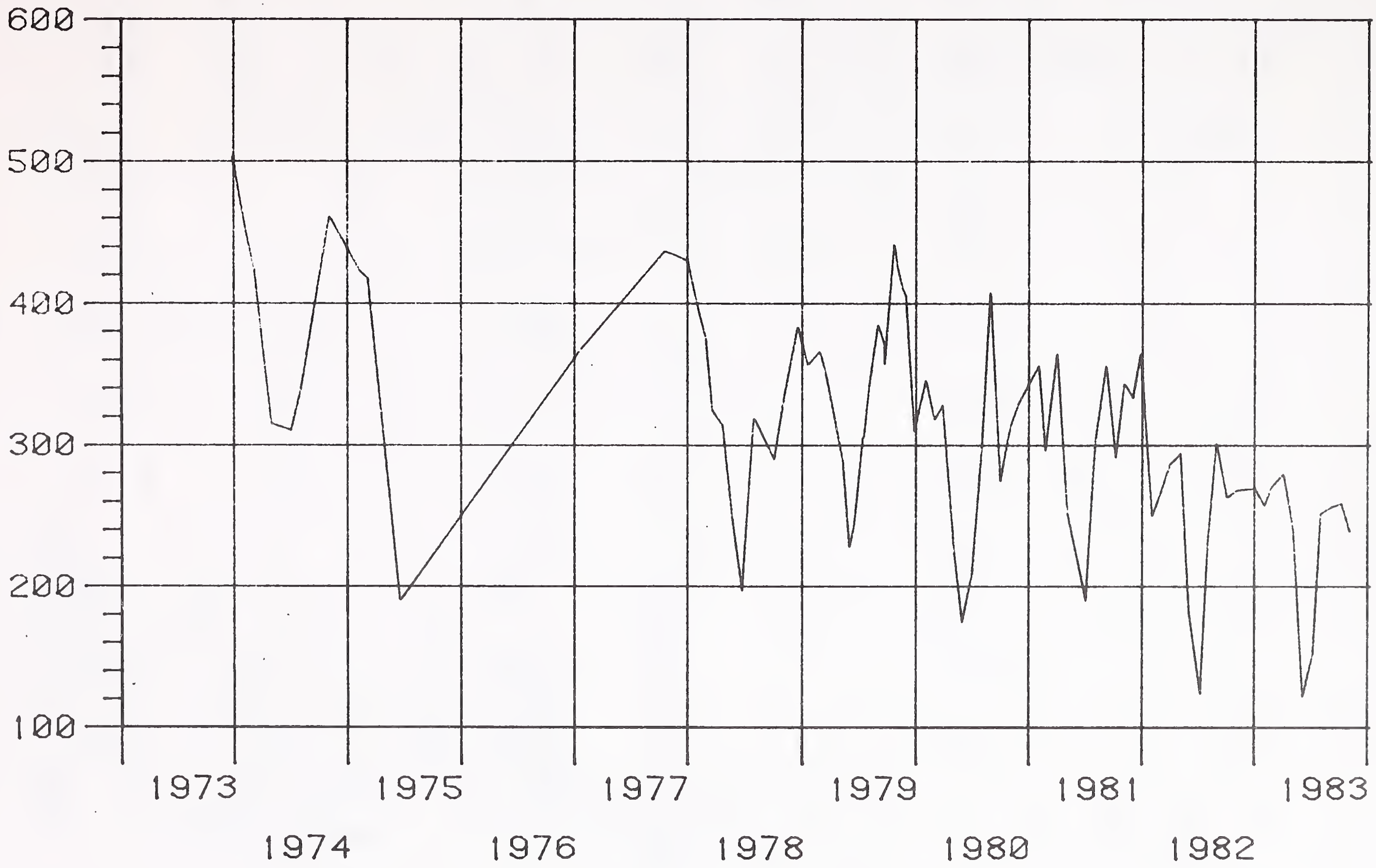
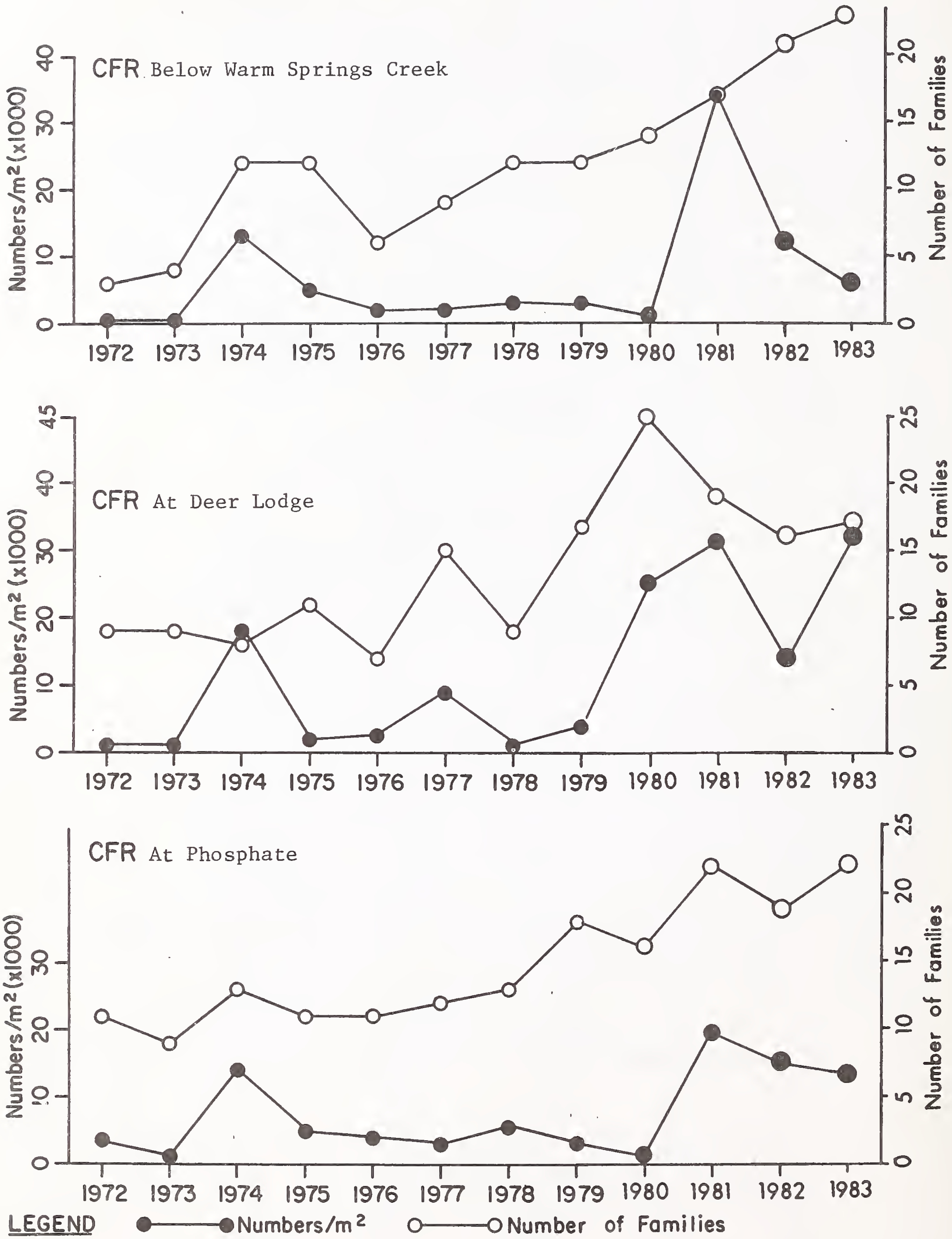


Figure 6. Density of macroinvertebrates (numbers/m^2) and number of macroinvertebrate families for three upper Clark Fork River stations from 1972-1983. (Source: Chadwick and Associates. 1984. Aquatic Biological Survey of Silver Bow Creek and upper Clark Fork River. Littleton, Colorado 80120)



variables and benthic biology. The results of at least 15 prior studies, conducted by university researchers and the staff of the Blue Ribbons 208 Areawide Planning Organization, were available for before-after comparisons in every category of measurement.

Similar studies have been started for other streams receiving discharges from treatment plants scheduled for upgrading: The Bitterroot River (Hamilton), Hot Springs Creek (Hot Springs), Big Spring Creek (Lewistown) and Ashley Creek (Kalispell). These studies will be among the first in Montana to document water quality improvements resulting from the Construction Grants Program. Since 1972, more than 200 million dollars have been spent in Montana under this program to upgrade wastewater treatment plants so they conform to minimum treatment and ambient water quality standards.

A preliminary evaluation of the data collected in 1983 reveals that water quality in the East Gallatin River below the Bozeman plant outfall has improved significantly. Before upgrading, the Bozeman effluent resulted in a marked change in the density, diversity and composition of benthic organisms, whereas today there is no significant difference in these variables from above to below the outfall. Toxic levels of ammonia, dissolved oxygen sags and repugnant growths of bacteria have been eliminated. Although some algal growth-stimulating nutrients (nitrogen and phosphorus) are still released by the treatment plant, their concentrations are much lower than before. Tests conducted in 1983 indicted no significant differences between rates of chlorophyll and biomass accrual on artificial river substrates at stations above and below the outfall.

Detailed findings from the 1983 East Gallatin River study will be presented in a separate report. They are expected to show that the Bozeman wastewater treatment plant is no longer the principal source of water quality contamination in the river.

The water pollution severity analysis performed for the 1984 305(b) report indicates that the criteria for several water quality variables are still exceeded regularly. These exceedences may impair use of the river for recreation, public water supply and propagation of fish and aquatic life. Probable sources of contaminants are agriculture, on-site domestic waste disposal, urban runoff and uncontrolled sources in the Bozeman area.

The final test of recovery in the East Gallatin River will be the fishery. If fish surveys conducted by the DFWP indicate it has achieved its full potential, then the river can be upgraded to B-1 (growth and propagation of salmonid fishes and associated aquatic life). If not, then the remaining sources of contamination will need to be identified and controlled. In any event, instream monitoring should continue to determine whether existing pollution controls are adequate to prevent water quality degradation in the face of population growth and urbanization in the Gallatin Valley.

PUBLIC WATER SUPPLY

The WQB has been given full responsibility by the EPA for administration of the Safe Drinking Water Act. The program is concerned with 2,042 public water supplies, of which 615 are community systems (cities, towns, subdivisions and trailer courts). The remainder are non-community systems (mostly bars, campgrounds, cafes and motels). An important aspect of the public water supply program is to monitor the water to ensure that bacterial, chemical and radiological quality remains within safe limits. Additionally, the WQB attempts to inspect each public water system annually and maintain close working relationships with local operators. Montana's laws and regulations also require that the WQB review and approve all construction and modifications to public water and sewer systems.

The public water supply program has changed dramatically in the past few years. While the staff has doubled, the number of regulated public water supplies has multipled six to seven times the original number. The program's growth necessitated a complete revamping of the WQB's record keeping system, thus streamlining efforts to obtain compliance with the regulations. Also, the addition of a word processor has increased efficiency.

Personnel in the water supply program confer daily with public and private water system operators and assist them in solving an array of problems. These problems include bacteriological and chemical contamination, equipment failure, taste and odor complaints, operator training needs and necessary water system improvements.

The public water supply program has concentrated on bringing systems into compliance over the past two years. This involved a large investment in staff time, and resulted in an increase in legal costs. Decreased funding coupled with increasing costs made achieving program goals difficult. Consequently, emphasis has been placed on increasing efficiency and prioritizing goals, projects and needs.

PERMITS AND ENFORCEMENT

The Permits and Enforcement Program administers: 1) the Montana Pollutant Discharge Elimination System (MPDES), 2) the Montana Surface Water Quality Standards (MSWQS), 3) the Montana In Situ Mining of Uranium Control System (MIMUCS) and 4) the Montana Groundwater Pollution Control System (MGWPCS).

Under MPDES, all point-source waste discharges to surface waters must be permitted by the WQB. Each permit contains limitations and conditions which ensure that state water quality standards will not be violated by the discharge. The WQB has 180 days to process an application, which includes public participation and a hearing, if requested. The WQB requires self-monitoring by permittees, conducts field inspections and monitoring and takes enforcement actions to bring dischargers into compliance with permit conditions. Permits are reevaluated and renewed on a regular basis, not to exceed five years. All information on permits is supplied to the EPA.

Under MSWQS, complaints of water pollution are investigated and resolved; plans for short-term instream construction are reviewed and modified to reduce the effects on water quality, and plans for leach pads, tailings ponds and ponds used in the processing of ore are reviewed to ensure that toxic chemicals will not escape and degrade water quality. MSWQS are also used as a basis for MPDES permit conditions.

MIMUCS requires the WQB to review plans and process permits for in situ or "solution-mining" of uranium. This is a complex technology and will require special expertise to review the applications if such mining occurs. The uranium market is currently down and companies are not interested in this sort of mining.

MGWPCS, approved by the Board of Health in October 1982, includes groundwater quality standards, a classification system, a permitting program for potential sources of pollution and a nondegradation policy. MGWPCS requires the WQB to review certain activities which could pollute groundwater. Activities covered by other permit programs (such as mines under DSL operating permits) are reviewed cooperatively with the WQB to ensure compliance with standards. The DHES has signed a memorandum of understanding with the DSL to formalize this process.

General Permits

The permits program promulgated general permit regulations through the Board of Health in June of 1982. Since then, MPDES general permits have been issued for small suction dredges, facultative sewage lagoons, feedlots and construction dewatering operations. These permits enable applicants in the listed category to be assigned the appropriate general permit for operation. This has saved processing and administrative time.

Other categories in which the WQB will probably develop general permits in the near future are fish farms and building foundation drain discharges.

Permitting Activities

The WQB Permits Section administers about 400 MPDES permits. In 1982, 42 new MPDES applications were received and in 1983 there were 35 new applications, in addition to those handled under general permits. Including renewals, 79 MPDES permits were issued in 1982 and 73 in 1983. This does not include an additional 64 authorizations under general permits. Administering the program includes corresponding with permittees, reviewing approximately 1,500 self-monitoring reports a year, following up on violations, compliance monitoring and inspecting facilities.

The section is working with the EPA to implement industrial pretreatment programs in larger Montana municipalities. Development of programs in Billings, Great Falls and Missoula began in 1983, and approval should occur in 1985. Additional programs are being developed in other municipalities.

The groundwater program, although newer and smaller than MPDES, also involves significant staff resources. The activity of the WQB in the groundwater program to date has been:

1) Groundwater permits issued - 20,

2) Applications in process - 5,

3) Fuel spills and contaminated groundwater incidents investigated - 47 and

4) Joint reviews of projects (permitted under other laws or regulations) for inspecting plans and monitoring compliance with groundwater standards - 15.

Examples for each of the above categories include:

1) Small mining and milling operations, such as cyanide leach,

2) Facilities and tailings ponds, such as East Helena ASARCO smelter and private industrial landfills and waste piles,

3) Fuel spills, storage tank and pipeline leaks, such as at Miles City and Lincoln, and toxic substances such as the cyanide escape at the Golden Sunlight Mine at Whitehall and at Motherlode in the Helena Valley and

4) Large mining and milling operations such as Montoro, CoCa Mines and the ASARCO Troy project (all covered under DSL regulations); major Facility Siting Act projects, such as Colstrip and the Salem projects; construction grant projects for wastewater treatment, particularly those involving rapid infiltration or land application, and other joint reviews such as hazardous waste and landfill site applications and maintenance, subdivision waste treatment systems and Superfund site clean-up operations.

Water Quality Complaints and Enforcement

Enforcement activities and responses to water quality complaints are placing more and more demands on WQB resources. Public complaints have been received at a rate of approximately 110-125 a year, and there have been 8-10 formal enforcement actions each year.

Enforcement actions range from phone calls and letters to formal district court law suits. Since mid-1982, the WQB has resolved 11 formal actions and collected $37,000 in civil penalties and $14,332 in agency costs.

From January 1 to October 15, 1984, six enforcement actions initiated pursuant to the Montana Water Quality Act have resulted in the collection of $29,250 in civil penalties and $5,750 in agency costs. This brings the totals collected to $217,350 in civil penalties plus $19,638 in agency costs since the WQB enforcement program began.

During the same period, four enforcement actions initiated pursuant to the Montana Safe Drinking Water Act have resulted in the recovery of $1,152 in agency costs, bringing the total to $1,982 since the first cost recovery in May 1983.

All money recovered in 1984 has been deposited in the State General Fund. Below is a summary of the 1984 enforcement actions resulting in penalties or the recovery of costs. In each case, court-ordered corrective actions were implemented in addition to the penalties and costs paid in settlement.

Water Quality Act

	Civil Penalty	Agency Costs Recovered
Transbas	$5,000	$ 500
CMStP&PRRCo-Miles City	7,500	500
Wood-Vick Placer	2,000	500
Brazill-Washington Gulch	6,500	3,500
Garrison Truck Stop	1,250	250
City of Columbia Falls	7,000	500

Safe Drinking Water Act

	Agency Costs Recovered
Springdale Colony	$590
Thiel Trailer Court	200
Mission Meadows Trailer Court	200
Hilldale Colony	162

Problems and Recommendations

The existing regulations and level of effort appear effective with respect to water pollution control in Montana. However, the Permits Section is experiencing manpower problems. Often there is not enough time to review and follow-up projects to the satisfaction of the staff. There is little time for routine compliance sampling of the "minor" dischargers in the state. Site visits are limited to less than 50 percent of new "minor" dischargers before permits are granted. It is difficult to investigate and follow-up all complaints in a timely fashion. Investigations of groundwater problems are particularly difficult and time consuming due to the difficulties of sampling and predicting the fate and destination of underground pollutants. The shortage of manpower also limits and delays the implementation of a pretreatment program.

The major difficulty in the administration of the water pollution control program is the limited funding and staffing to do the job. The addition of the groundwater pollution control program, without accompanying funding or manpower, has greatly affected the amount of time and attention that can be given to each problem.

The WQB feels existing laws and regulations are adequate, with periodic amendments, to control water pollution. A possible modification would be the creation of a fund for the investigation of groundwater pollution. Often, especially in cases where pollution may have originated from more than one source, the potential contributors are reluctant to initiate investigations, fearing it would be an admission of guilt. This can create delays in determining the responsible party and getting the problem resolved.

Another possible modification might be to initiate legislation allowing the WQB or some other agency, such as the DSL, to require a fund be established by a mining company for long-term maintenance of tailings structures or other possible pollutant discharge after the company has abandoned the property. Often, water pollution at these sites can be controlled with a minimum of maintenance. However, problems can arise after abandonment, when no responsible party is left to maintain the property.

A change in the MPDES rules would be necessary to add a category of general permits for foundation drains. Foundation drains were not previously permitted under MPDES, but have been added because of a recent legal opinion received by the Permits Section.

CONSTRUCTION GRANTS

The federal program to fund the construction of wastewater treatment facilities began in 1956. The Federal Construction Grants Program was passed into law in 1956, and ultimately it became one of the largest public works programs.

The recent interest in rebuilding wastewater treatment plants has stimulated federal support in the EPA Construction Grants Program. The future of the program, however, is unknown until the Clean Water Act is reauthorized. It is presumed it will be continued.

The program has remained stable since the passage of the Municipal Wastewater Treatment Construction Grant Amendments in 1981, but the changes that occurred on October 1, 1984 could have a major impact on the program. The increase in local funding necessitated by the reduction of federal participation from 75 percent to 55 percent will reduce the number of communities that are financially able to build, operate and maintain improved wastewater treatment facilities.

Montana's need for wastewater treatment facility improvements now exceeds the authorized level of federal funding. With reduced federal participation and an increase in local needs, Montana's efforts to provide adequate local wastewater treatment will be slowed.

Accomplishments

The Construction Grants Program has been administered by the DHES since 1981. This has resulted in stability and made the program more attuned to problems unique to Montana. Since delegation, a spirit of cooperation has grown between public entities, consultants and the DHES that did not exist previously. The projects receive continuous monitoring and assistance, thus reducing time-consuming delays.

During the last two years, the DHES has approved more than 25 major grants for the design and construction of wastewater treatment facilities. Libby and Lewistown received grants to replace the last of the antiquated primary wastewater treatment plants. Numerous communities received funds to upgrade wastewater lagoon systems.

One major success has been the progress toward the construction of a sewer to serve Billings Heights, an area adjacent to Billings. For years the sewer district and the City of Billings were deadlocked in negotiations to develop a sewer line. After the defeat of two bond elections, a new group of individuals designed a program acceptable to the city, rallied public support and now have the project in the design stage. The 20 million dollar project will be funded in phases. The completed sewer should rid the area of numerous failing septic systems and sewage seeps.

Chester received a grant to eliminate its unsafe wastewater lift stations and lagoon improvements. Bids for the project exceeded the engineering estimates, so after some design changes suggested by the DHES, and agreed upon by the community, the project was successfully re-bid at a 20 percent reduction in cost.

Due to the unprecedented blooms of algae in Flathead Lake, the DHES developed a strategy for limiting phosphorus in Flathead Lake. This calls for a 1.0 mg/l effluent limit of phosphorus on all permits for point sources in the Flathead Lake drainage basin. Kalispell, Bigfork, Whitefish and Columbia Falls will have phosphorus limits imposed on their MPDES permits. These communities along with Lakeside, an unsewered community, will receive assistance from the EPA Construction Grants Program to pay for phosphorus removal equipment. These control measures should remove more than 15 percent of the phosphorus available to algae in the lake.

Some facilities receiving EPA construction grants are being run inefficiently. Because of the tremendous public investment involved, the DHES, in conjunction with EPA and Northern Montana College, hired a consultant to do wastewater treatment plant diagnostic evaluations and on-site training of wastewater treatment plant operators. Seven communities were selected and the technical assistance is continuing. The results have been mixed: 1) Communities do not put a high priority on funding operation and maintenance of wastewater treatment facilities, especially replacement costs; 2) communities have a high dependence on outside financial assistance, and 3) a little training and technical assistance has resulted in attention to problems and needs at wastewater treatment facilities and effective new treatment techniques without major capital investments.

Problems

The major problem concerning the construction grants program is the reduction in the federal share from 75 percent to 55 percent, resulting in a financial burden to smaller communities. These communities have a substantial backlog of needs. Even though the state's largest municipalities have completed their major wastewater treatment facilities, the remaining projects are requiring the communities to resort to "creative" or alternative financing in lieu of federal support.

Objectives

The primary objective of the Construction Grants Program is to provide financial assistance to communities that have not completed wastewater treatment facilities. Millions of dollars worth of work needs to be done on wastewater treatment in Montana to bring existing facilities into compliance and to reduce public health hazards.

The DHES will continue to work with all grantees to plan, design and construct wastewater facilities that are cost effective and environmentally sound. The DHES will also work with other funding sources to insure that highest priority projects are constructed, and that financial strategies are developed to build, operate and maintain facility improvements.

An additional objective is to insure the adequate operation of the completed projects. Through training sessions and on-the-job assistance, the DHES will assist the communities in operating their facilities efficiently and in accordance with permit requirements.

TECHNICAL STUDIES SUPPORT

The surface water quality standards for Montana are being reviewed and revised, as necessary. Numerous improvements to the water quality data system have been made, including provisions to increase our use of STORET. An increased effort has been made to review the nutrient impact of lakeshore developments, the water quality effects of hydroelectric power plants, mining and milling developments, and industrial and municipal discharges.

WATER QUALITY MANAGEMENT

In March 1983, the DHES prepared a Clean Water Act Section 205(j) work plan for state fiscal years 1984 and 1985. EPA awarded a $185,176 Water Quality Management Planning Assistance Program grant to the DHES on May 31, 1983. This grant was to provide funding for water quality management activities for state FY 1984. Another grant of $159,161 was made for work in state in FY 1985. The state contributed $38,276 towards the program in FY 1984 and $39,730 in FY 1985.

EPA 205(j) funds were utilized primarily to support 4.75 full time employees of the DHES Water Quality Bureau staff involved in statewide water quality management planning activities. Funds also were used to provide assistance to three county soil and water conservation districts for water quality management activities. The 208 Areawide Water Quality Management agencies in Montana have discontinued active efforts, and were not involved in Montana's 205(j) program.

Individuals and activities supported by 205(j) funds were in many cases also supported partially by Section 106 water pollution control program grant funding. Montana's 106, 205(j) and 205(g) (Construction Grants administration) work activities are well integrated. The water quality management activities described in this summary were supported primarily with 205(j) funding, however 106 program grant funds and state funds also were involved.

Eight principal work program elements were carried out using 205(j) funds. These are described below. (See also Monitoring and Special Problems for a more detailed description of some of these water quality management activities.)

Clark Fork River Monitoring

The upper Clark Fork River and Silver Bow Creek are priority waterbodies. Their drainage includes three Superfund sites, several major MPDES discharges and a potential Abandoned Mine Land Reclamation site. Many active and former construction grant projects are also located on these stream segments.

Six ambient water quality monitoring stations were established on Silver Bow Creek and the upper Clark Fork River. An array of monthly chemical and physical analyses are being carried out at these stations. The stations are located on: the Clark Fork River at Warm Springs and Garrison; Silver Bow Creek above and below the Warm Springs ponds; Warms Springs Creek at its mouth, and the Mill-Willow Bypass at its mouth. Monitoring at these stations supplements similar monitoring carried out at Deer Lodge on the Clark Fork River since 1974.

In addition, a detailed two-year water quality monitoring program was developed and begun early in 1984 for the lower Clark Fork River. This program entails monitoring at about 30 stations on the Clark Fork River and major tributaries from the Blackfoot River to the Idaho line. The program was developed in response to a major controversy which developed during state FY 1984. This controversy involved the alleged impacts resulting from a

modified discharge permit issued to the Champion pulp and paper mill on the Clark Fork River at Frenchtown.

Data from these monitoring efforts are entered into the DHES water quality data storage and retrieval system and STORET. Results provide feedback to water pollution control program managers and are incorporated into the state's 305(b) water quality assessment. Results from these and other monitoring efforts were utilized to revise and update Montana's priority waterbodies list.

Before-and-After Studies at Wastewater Treatment Plants

Four before-and-after studies of receiving streams following the completion of wastewater treatment construction grant projects were initiated in 1983 and another in 1984. These studies are intended to document and demonstrate the water quality improvements resulting from the multi-million dollar expenditure of construction grant funds.

The studies are being carried out at wastewater treatment plant sites on the East Gallatin River (Bozeman), Big Spring Creek (Lewistown), Bitterroot River (Hamilton), Hot Springs Creek (Hot Springs) and Ashley Creek (Kalispell). All five receiving streams are priority waterbodies. Monitoring has been performed to fully document the "before" conditions on four of the five receiving streams. In addition, "after" conditions have been documented on the East Gallatin River for comparison with "before" conditions recorded by numerous investigators in previous years.

A summary of the results for the East Gallatin River have been incorporated into this report. A significant water quality improvement has been identified as a result of upgrading treatment at the Bozeman plant. The four remaining construction grant projects have not been completed. "After" conditions for these four remaining receiving streams will be established following completion of the construction grant projects. Preliminary findings on the recovery of these streams will be incorporated into subsequent 305(b) reports. A final report fully describing the before-and-after studies will be prepared for each stream.

Freezeout Lake/Priest Butte Lakes/Teton River Water Management Plan

The Teton River, one of Montana's priority waterbodies, has been degraded by saline discharges from Freezeout Lake. Freezeout Lake is a State managed waterfowl refuge. The lake serves as a sink for irrigation return flows and drainage from a large irrigation district. Evaporation exceeds precipitation in the area, thus concentrating salts in Freezeout Lake. The only discharge from Freezeout Lake is to the Teton River through the Priest Butte Lakes. The saline discharges to the Teton River from Freezeout Lake impair downstream irrigation uses and adversely affect aquatic life.

A water management plan was prepared for Freezeout Lake. This plan includes a schedule for flow releases from Freezeout Lake to keep downstream Teton River salinity levels below 1,000 micromhos. The state waterfowl refuge manager has implemented this water management plan. DHES staff continue to work with the refuge manager to refine the management scheme.

Monitoring is also being performed to document Teton River water quality improvement resulting from implementation of the plan.

Monitoring Yellowstone River Water Resource Development Relative to the DHES Instream Flow Reservation

The DHES secured an instream flow reservation on the Yellowstone River in 1980. The reservation was for the purpose of protecting public water supplies. The DHES 205(j) work plan identified a significant effort to monitor water development and diversion activities to ensure compliance with the instream flow agreement. The actual effort expended in State FY 1984, however, was less than anticipated due to little water development activity. A summary of water development activity relative to the instream flow reservation is included in this report. (See Special Problems: Stream Dewatering.) The DHES is cooperating with the DFWP in its effort to obtain an instream flow reservation for the protection of aquatic life in the Clark Fork River.

1984 305(b) Report

The DHES water quality management planning staff were involved in the preparation of this 1984 Montana 305(b) report. This included the following: performance of additional monitoring to collect data on stream segments with little data; identifying and collecting existing data from several sources and entering it into STORET; reviewing and evaluating computerized pollution severity analysis printouts to revise the priority waterbodies list, and writing, assembling and editing the final text of the report. A preliminary draft of this report was submitted to EPA at the end of June 1984.

The DHES has adopted the 305(b) report as its main mechanism for assessing and reporting statewide water quality conditions. It also serves as a means of summarizing and communicating water pollution control program activities to the public and to other interested agencies. The priority waterbodies list is used to direct water quality management and pollution control activities of the DHES. Other agencies and programs also utilize Montana's 305(b) report as a guide in directing program efforts (e.g., the U.S. Forest Service, Bureau of Land Management, Soil Conservation Service, Agricultural Stabilization and Conservation Service, Montana Department of Natural Resources and Conservation, Montana Department of State Lands and Montana Department of Fish, Wildlife and Parks). The 305(b) report is an important element of the state's overall water quality management program.

Computerized Biological Water Quality Data System

In 1977 the DHES Water Quality Bureau began a biological water quality monitoring program encompassing 85 stations on 60 streams. In addition, many intensive surveys have been conducted in recent years which involve collection of biological data. In 1984 the DHES initiated an effort to establish a computerized biological water quality data storage and retrieval system. The following activities have been completed: the kinds and amounts of biological data have been inventoried; variables and parameter codes have been selected; new data fields have been established, and the computer system has been modified to accept these data fields.

Additional activities remain to be carried out to fully establish the computerized biological data system: Organizing the existing data for easy loading and designing bench sheets to facilitate future loading; writing a data entry program; reorganizing the existing data file; loading the data; writing retrieval and data editing or quality assurance programs, and testing and applying the system.

Assistance to County Conservation Districts

Montana's Statewide 208 Water Quality Management Plan (WQMP) designates county soil and water conservation districts as the nonpoint source water quality management agencies for non-federal land in the state. Cooperative agreements between the DHES and all 57 conservation districts in Montana have been signed.

Most Montana conservation districts are managed by a board of supervisors who are themselves farmers and ranchers who volunteer their time and services. They usually have a staff consisting of a single clerk. The state WQMP recommended that the DHES Water Quality Bureau designate an environmental specialist to work with and assist the conservation districts. This work includes the following: Identifying nonpoint source water quality problems and potential solutions; developing proposals for 205(j) pass-through funding; coordinating conservation district water quality management activities with those of the DHES and other state and federal agencies; assisting the districts in obtaining support for the implementation of water quality improvement projects; and maintaining the visibility and awareness of water quality as a consideration in the daily activities of the agricultural community.

In addition to this coordination/assistance effort, $22,000 was passed through to the Jefferson and Lewis and Clark conservation districts to prepare a stream corridor management plan for Prickly Pear Creek.* This plan included an analysis of water quality problems, an evaluation of alternative solutions, and an identification of recommendations to implement specific solutions. DHES staff are assisting the conservation districts in procuring state funding for implementation of the plan recommendations.

The DHES has also utilized 205(j) funding to assist the Stillwater County Conservation District with a saline seep investigation. Approximately $5,400 were provided for the monitoring of groundwater quality. The Soil Conservation Service and Montana Bureau of Mines and Geology were also participating in this project.

DHES staff, along with the SCS, have assisted the Stillwater and Meagher conservation districts in conducting two stream dynamics workshops in September 1984. These workshops were intended to educate conservation district officials about natural hydrologic processes and stream ecology. Field tours were conducted on a tributary of the Smith River and on Rosebud Creek in association with these workshops.

----

*Streamworks, Inc. 1984. Prickly Pear Creek: A Stream Corridor Management Plan. Helena.

The DHES has also assisted the Cascade County and Teton County conservation districts with efforts on Muddy Creek, one of Montana's priority waterbodies. (Muddy Creek is one of Montana's worst erosion problems. Over 200,000 tons of sediment are contributed by Muddy Creek to the Sun and Missouri rivers annually.) A report documenting the impact of Muddy Creek sediment upon downstream biota was published by the DHES Water Quality Bureau in January 1984. In addition, the DHES arranged to have aerial photographs taken of Muddy Creek. These photographs will be used in future efforts to conduct a streambank inventory for Muddy Creek.

Miscellaneous Water Quality Management Activities

The DHES water quality management planning staff performs many activities that do not appear significant individually, but which have significant cumulative demands for time and resources. This includes many water quality management planning activities that were not anticipated when the two-year work program was developed.

The following are miscellaneous activities that were conducted in 1983 and 1984:

1) Prepared quality assurance program plans and water quality monitoring project plans, and revised and updated laboratory and field standard operating procedures.

2) Maintained computer and paper files of water quality data.

3) Reviewed National Forest Management Plans and monitored compliance with the DHES-U.S. Forest Service Cooperative Agreement. Reviewed forest resource development activities in watersheds which serve as municipal water supplies.

4) Reviewed Bureau of Land Management activities and monitored compliance with DHES-BLM Cooperative Agreement.

5) Reviewed other resource development activities (recreational, coal, minerals, water, timber) for impacts on water quality.

6) Reviewed construction grants priority lists, permit limitations, and water quality standards for compatibility with the State 208 WQMP.

7) Investigated leaking underground storage tanks.

8) Conducted water quality surveillance and monitoring in response to complaints, leaks and spills, and conducted water quality surveys as needed for the establishment of discharge permit limitations.

9) Helped to prepare an environmental review document for a controversial modified pulp and paper mill discharge to the Clark Fork River.

10) Helped to develop a strategy for limiting phosphorus inputs to Flathead Lake, one of Montana's priority waterbodies.

11) Prepared the Montana section of a national report that documents progress in water pollution control since 1972.

12) Provided comments to the National Nonpoint Source Task Force.

13) Provided ambient water quality information for Montana to the 1984 EPA Construction Grants Needs Survey.

14) Helped to monitor the 1984 toxic algae bloom on Canyon Ferry Reservoir and to provide up-to-date information to the public.

GOALS AND ATTAINMENT

Back in 1972, Congress set two goals in the Federal Water Pollution Control Act:

1. Make waters fishable and swimmable by 1983, and

2. Eliminate the discharge of pollutants by 1985.

These goals have been criticized as being hopelessly naive and unrealistic, but they should be remembered for what they are--goals.

1983 has come and gone and some Montana waters still are not swimmable and fishable. Of the 19,168 miles of streams in the state, 60 miles in the following seven segments do not support any of the five designated uses covered in the stream problem assessment (does not include industrial use):

Corbin Creek (tributary of Spring Cr./Prickly Pear Cr.)
Fisher Creek below Glengary Mine
High Ore Creek below Comet Mine
Mike Horse Creek below Mike Horse Mine
Prickly Pear Creek (dewatered section below East Helena)
Silver Bow Creek
Spring Creek below Corbin Creek

Although lower Prickly Pear Creek and Silver Bow creek are classified for agricultural and industrial use only, their waters are frequently unsuitable even for agricultural purposes because of dewatering and heavy metals pollution, respectively.

The remaining 1,105 stream miles and 63 segments listed in Table 2 support at least one, but not all of the uses for which they are designated. The remaining 18,003 miles of streams in Montana are presumed to fully support all of their designated uses. However, information is available to assess only 17,251 of the stream miles in the state.

Regular monitoring data are available to document water quality trends on 3,663 miles of streams in Montana. Since 1972, these data show that water quality was maintained in 3,249 miles, improved in 374 miles, and apparently degraded (thermally) in 40 miles of the Madison River below Ennis Lake. (Trends on the remaining 15,505 stream miles in the state are unknown.) Most of the documented improvement was due to upgrading municipal and industrial wastewater treatment systems, such as the ones at Bozeman and at the Anaconda Company in Butte.

Two immediate goals of water quality managers in Montana are (1) to reduce the backlog of polluted waters in Table 2 and (2) to hold the line against the degradation of high quality waters.

In the near future (next five years), the only real hope to reduce the backlog in Table 2 will be from upgrading additional wastewater treatment plants, such as the scheduled upgrades at Kalispell, Lewistown and Hot Springs. Reclamation of abandoned or inactive hardrock mining sites will be slower and more expensive to accomplish, assuming funds and practical

solutions can be found. The Natural Resources Legacy Program proposed by Governor Schwinden would attempt restoration of sites where a liable party cannot be found and where other programs (e.g., Superfund and AML) do not apply. Until there is a large infusion of funds to implement nonpoint-source controls, not much headway will be made in correcting the many agricultural problems.

Water quality managers, programs and budgets are being stretched to the limit in preventing degradation of high quality waters. The recent upsurge in placer, suction dredge and hardrock mining in Montana requires additional monitoring and surveillance. National Forest Plans predict large increases in sediment yields from forested watersheds, while Forest Service watershed protection, monitoring and rehabilitation budgets are woefully inadequate. The agricultural economy is depressed and conservation programs continue to stress production and efficiency, while protection of water quality receives little attention. Chronic agricultural problems such as dewatering and saline seep continue unabated. A rash of leaking underground petroleum product storage tanks threatens local drinking water supplies. And long forgotten dumps of hazardous wastes are being uncovered throughout the state.

In the summer of 1984, a dozen major forest fires burned out of control in Montana, some of them over very erosive landscapes. The 27,000-acre North Hills Fire near Helena was followed by torrential rains, which removed several inches of unprotected soils and created massive erosion and sedimentation problems in the drainage of Beaver Creek, one of the most important trout spawning tributaries of the Missouri River. Rehabilitation of fire-damaged areas will be costly.

Additional data will be collected in 1984 and 1985 to further refine the list of apparent and potential problem stream segments for Montana. The list probably won't be much shorter when the next report is written in 1986, but, with adequate funding for the pollution control programs, the list shouldn't be any longer.

APPENDIX

SUPPLEMENTAL INFORMATION

The geography that restricts water to certain courses is commonly called a drainage basin. Much of the information in this report refers to these geographically distinct areas.

The three major basins--the Clark Fork, Missouri and Yellowstone--are so large and diverse they have been divided into parts.

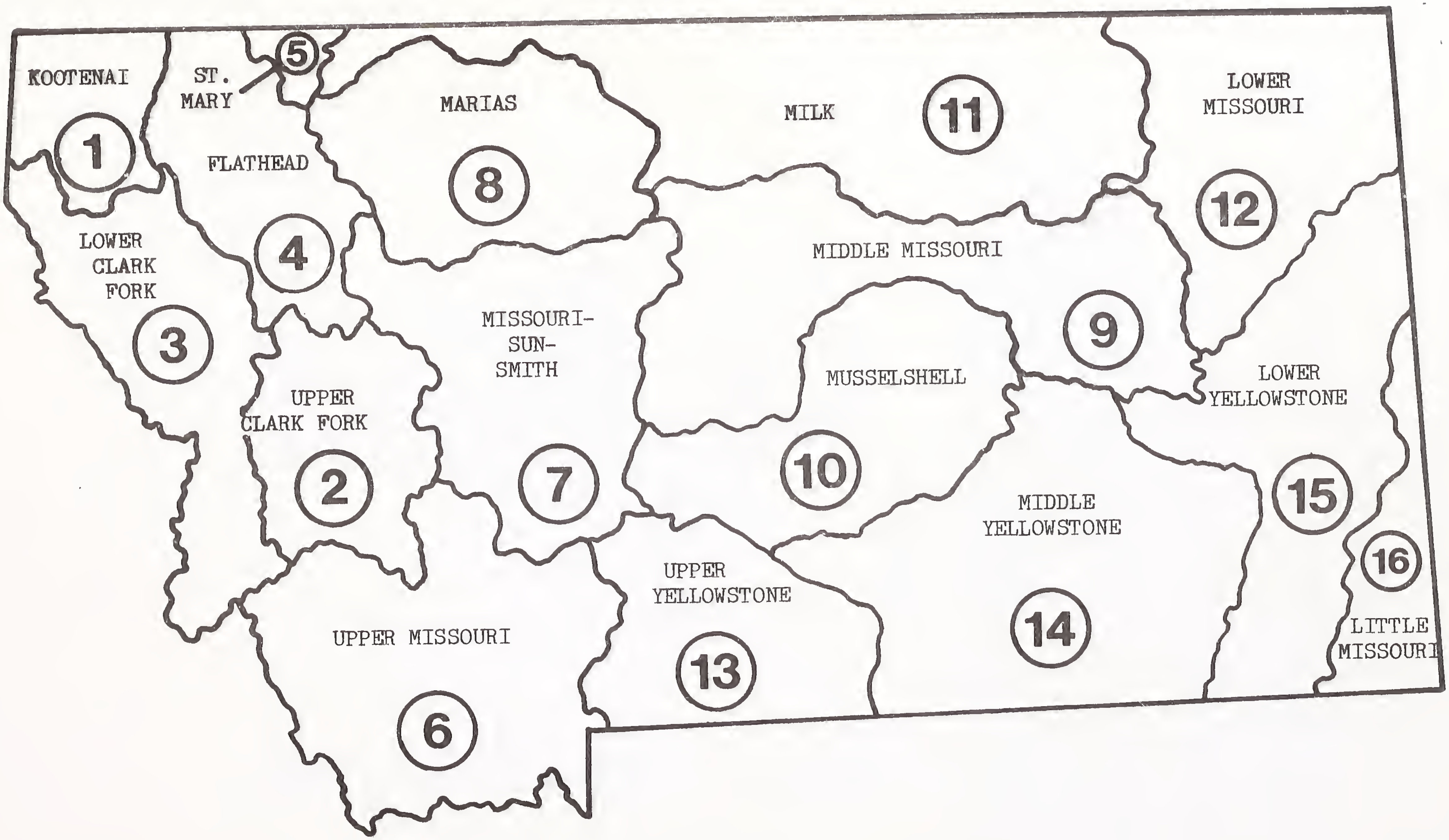
Montana's sixteen principal river basins are a convenient way to organize stream water quality problems. For each basin we present 1) a brief narrative description of physical features and natural water quality, 2) a list of apparent and potential problem stream segments with the probable impaired uses and the severity index and problem parameters for each impaired use and 3) a map showing principal towns and water bodies plus the location of each problem segment. The following is an explanation of the abbreviations used in the basin lists of apparent and potential problem segments:

Impaired Uses

A(C)	Aquatic life (cold water)
A(W)	Aquatic life (warm water)
P	Public water supply
R	Primary contact recreation
I	Irrigation
L	Livestock watering

Problem Parameters

Ammonia	Total ammonia (NH_3 + NH_4)
BOD	Biochemical oxygen demand
DO	Dissolved oxygen
FC	Fecal coliforms (bacteria)
Gases	Dissolved gases
Metals	Copper, cadmium, zinc, etc.
N	Nitrogen, total
NH_3	Un-ionized ammonia
NO_3	Nitrate
P	Phosphorus, total
pH	Acidity
SO_4	Sulfate
TDS	Total dissolved solids (salinity)
Temp	Temperature (too high)
TSS	Total suspended solids (sediment)


KOOTENAI
1
ST.
MARY
5
FLATHEAD
4
LOWER
CLARK
FORK
3
UPPER
CLARK FORK
2
MARIAS
8
MISSOURI-
SUN-
SMITH
7
UPPER MISSOURI
6
MILK
11
MIDDLE MISSOURI
9
MUSSELSHELL
10
UPPER
YELLOWSTONE
13
MIDDLE
YELLOWSTONE
14
LOWER
MISSOURI
12
LOWER
YELLOWSTONE
15
16
LITTLE
MISSOURI

1 - KOOTENAI RIVER BASIN

The Kootenai River Basin is a well-watered region of steep, heavily timbered mountains and narrow valleys. The area is sparsely inhabited and contains few industries and communities. Timber harvest, mining and tourism are the primary commercial activities. Agriculture is a relatively minor pursuit in the basin.

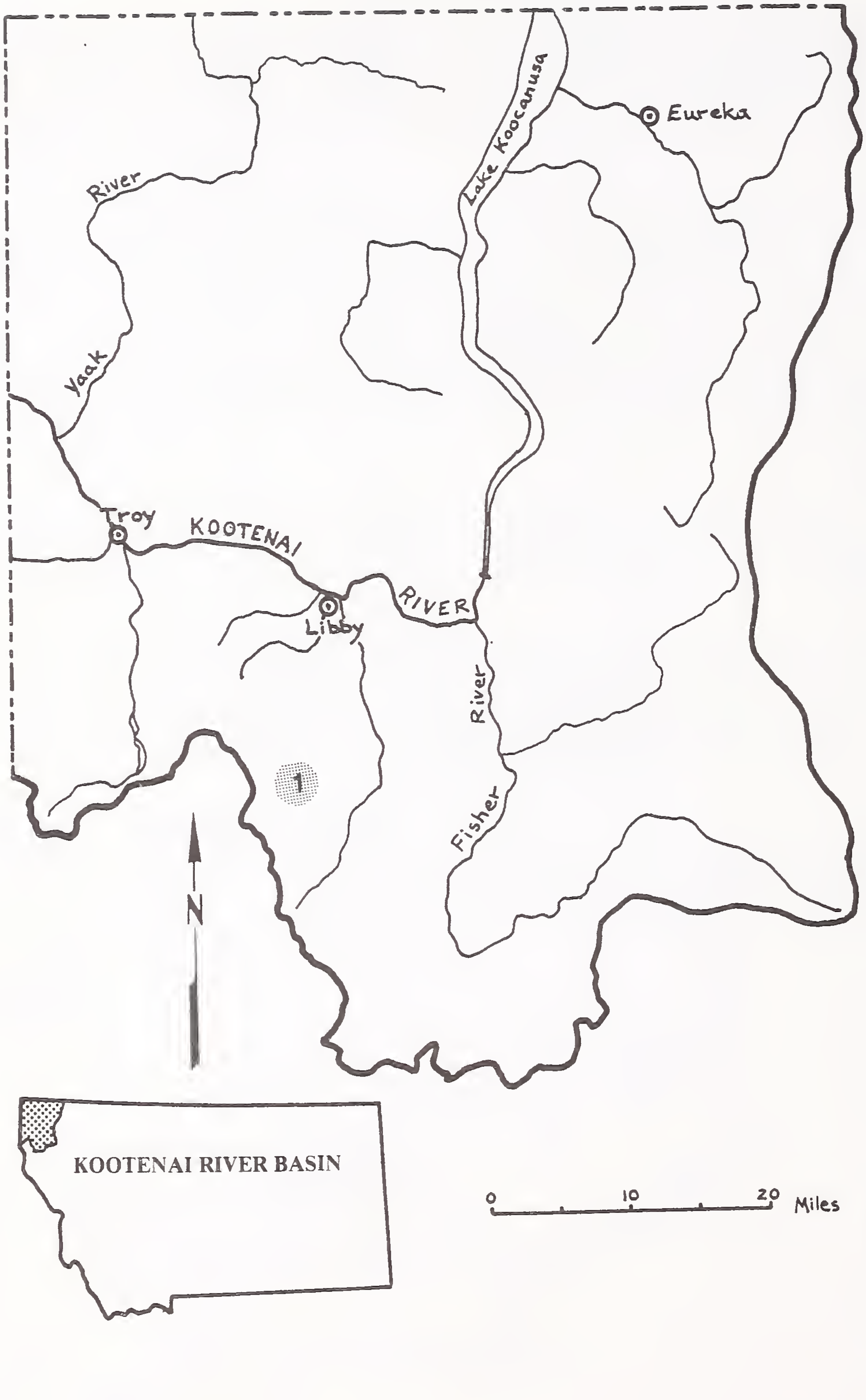
A major hydroelectric installation--Libby Dam--has turned a good share of the once free-flowing Kootenai River into slack water. Other hydroelectric developments on the Kootenai are contemplated, and a major copper and silver mining and milling facility is in operation near Troy.

Precipitation in the basin is about 24 inches per year in the valleys to more than 80 inches a year in the mountains. Elevations range from nearly 9,000 feet in the Cabinet Mountains to about 1,800 feet near Troy, the lowest point in Montana.

Forest soils present a moderate to severe erosion hazard. Commercially attractive copper, silver and vermiculite deposits have prompted exploration and mining. Roadless and wilderness areas attract increasing numbers of visitors each year.

The Kootenai River Basin includes some of the purest waters in America; concentrations of dissolved chemicals are among the lowest in Montana. Streams are significantly less productive and potentially more sensitive to acid mine drainage and heavy metals pollution than streams elsewhere in Montana.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Snowshoe Cr.	Big Cherry Cr.	A(C)	9.32	Zinc


Eureka
Lake Koocanusa
River
Yaak
Troy
KOOTENAI
RIVER
Libby
River
Fisher
1
N
KOOTENAI RIVER BASIN
0
10
20
Miles

2 - UPPER CLARK FORK RIVER BASIN

The upper Clark Fork River Basin contains moderately timbered and highly mineralized mountain ranges separated by broad agricultural valleys.

Elevations in the drainage range from over 10,000 feet in the Anaconda Range to slightly more than 3,000 feet near Missoula. Total precipitation generally increases with elevation, with more snowfall in the mountains. Valley precipitation varies from 8 to 20 inches annually, most of it falling in the late spring and early summer.

The basin comprises an area of 6,115 square miles or nearly four million acres. Forests cover 2.3 million acres, pasture and range 880,000 acres, urban and built-up areas 54,000 acres and lakes and impoundments 9,700 acres. Irrigated cropland covers 150,000 acres of the basin and dry cropland exceeds 23,000 acres. Irrigated agriculture accounts for the largest use of water in the basin; total diversion requirements for irrigation approach 500,000 acre-feet per year with a net depletion of nearly one-half that amount.

Water quality varies considerably within the basin. Silver Bow Creek below Butte has some of the worst water quality in the state, while Rock Creek near Missoula is considered by many as a "blue ribbon" trout fishery. Pristine, nearly sterile, high mountain lakes dot some of the higher mountain ranges in the basin, while eutrophic Georgetown Lake near Anaconda is one of the most productive fisheries in Montana.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Clark Fork R., Warm Springs to Garrison	Pend Oreille R.	A(C)	0.40	TSS, P, Iron, Copper, Cadmium
			P	1.61	TDS, SO_4, Iron, Manganese
			R	0.22	P, pH
			I	0.11	TDS, Magnesium
2	Clark Fork R., Garrison to Milltown Dam	Pend Oreille R.	A(C)	0.14	TSS, Temp, P, Copper, Iron, Cadmium
			P	0.21	TDS, SO_4, Lead, Manganese
			R	0.12	P
3	Douglas Cr. @ Philipsburg	Flint Cr.	P	2.60	Arsenic
			I	1.30	Arsenic
4	Elk Cr.	Blackfoot R.	A(C)	2.07	TSS
5	Mike Horse Cr.	Blackfoot R.	A(C)	7.54	pH, Iron, Cadmium, Zinc, Copper
			P	16.49	pH, SO_4, Lead, Cadmium, Manganese, Zinc, Nickel
			R	1.16	pH
			I	1.60	Cadmium
			L	1.56	Lead, Cadmium, Copper

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
6	Silver Bow Cr.	Clark Fork R.	A(C)	2.14	TSS, pH, N, P, Copper, Iron, Zinc, Arsenic
			P	11.00	SO_4, Arsenic, Zinc, Copper, Manganese, Cadmium, Selenium
			R	1.12	P, pH
			I	7.04	TDS, Arsenic, Selenium
			L	3.00	Arsenic, Copper, Lead, Selenium

Blackfoot
River
Bonner
Clark
Fork
River
Deer Lodge
Clark Fork R.
Anaconda
Butte
1
2
3
4
5
6
N
UPPER CLARK FORK RIVER BASIN
0
10
20
30
40
Miles

3 - LOWER CLARK FORK RIVER BASIN

The lower Clark Fork River Basin, along the western border of Montana, comprises an area of 8,900 square miles or over 5.5 million acres. This basin includes 1,900 square miles of the Flathead River drainage below Flathead Lake, 2,800 square miles in the Bitterroot River drainage and all of the Clark Fork River drainage below the Blackfoot River.

About 60 percent of the basin is in federal ownership, mostly national forest land. Cropland covers about 400,000 acres, two-thirds of which is irrigated. Principal industries in the basin are agriculture, tourism, logging and forest products. Rich copper and silver deposits on the south end of the Cabinet Mountains have been intensely explored in recent yers.

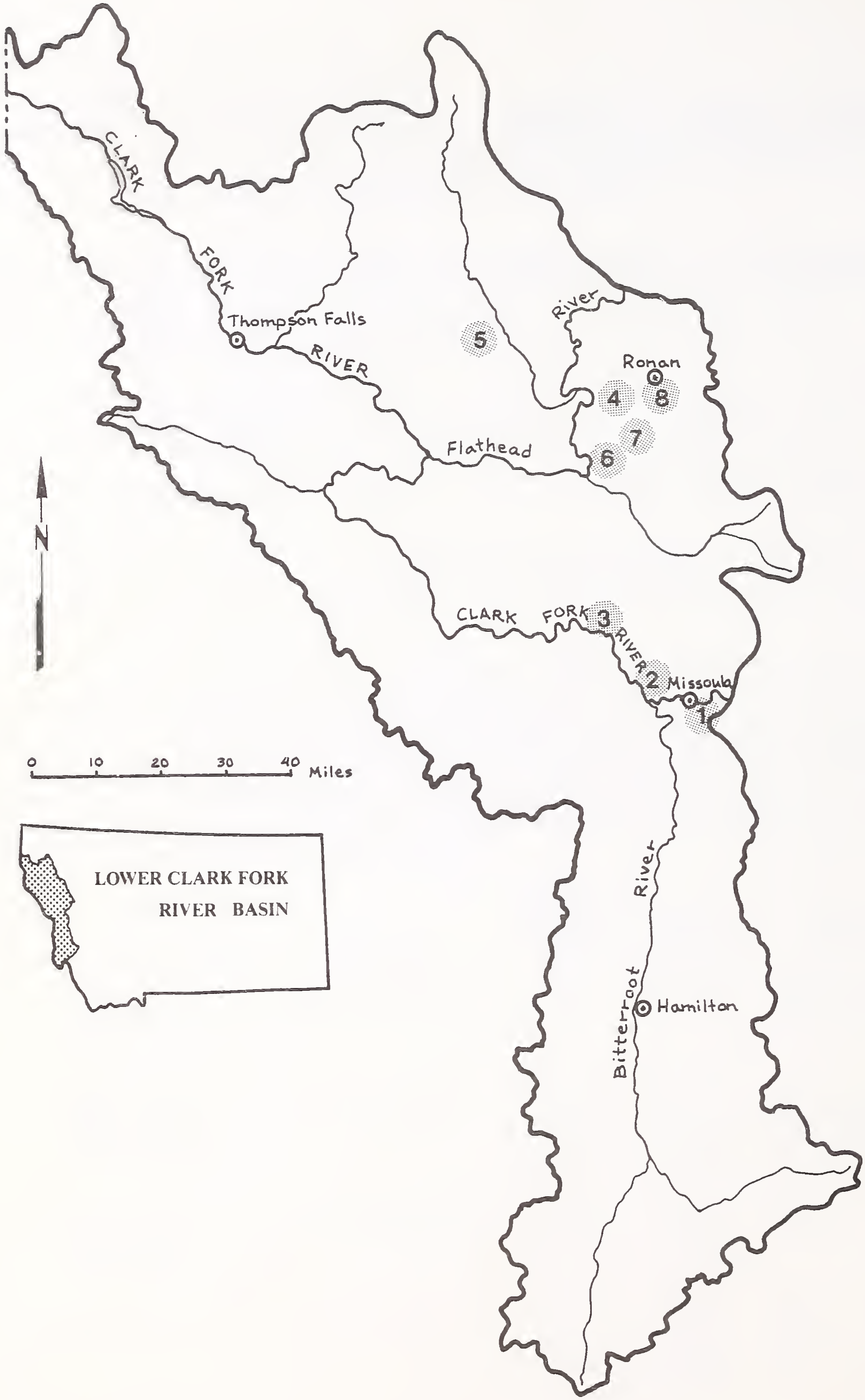
The climate in the lower Clark Fork River Basin is variable, depending on elevation. Annual precipitation ranges from less than 10 inches southwest of Flathead Lake to more than 40 inches in the higher mountains. Elevations in the basin range from more than 10,000 feet in the Bitterroot Range to about 2,000 feet where the Clark Fork River enters Idaho.

Although it accounts for only about 15 percent of the land area, agriculture is by far the largest water user in the basin. Annual diversion requirements for irrigation approach 1.6 million acre-feet of water with a net depletion of 760,000 acre-feet per year.

Water quality is variable. Generally, rivers and streams flowing through concentrated agricultural areas are degraded, with temperatures, dissolved solids and other variables indicating the effects of irrigation diversions and return flows. Municipal and industrial effects are present but subdued. Streams flowing through remote areas have excellent water quality tempered only by the effects of seasonal runoff. Water entering the basin near Missoula still retains some effects of municipal and industrial waste discharges far upstream in the Butte-Anaconda-Deer Lodge area.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Clark Fork R., Milltown Dam to Missoula	Pend Oreille R.	A(C)	1.42	Iron, Copper, Cadmium
2	Clark Fork R., Missoula to Frenchtown	Pend Oreille R.	A(C)	2.52	P, Iron, Copper, NH_3, TSS, Cadmium
			P	0.68	Iron, Manganese
			R	0.30	P, FC, pH
3	Clark Fork R., Frenchtown to Huson	Pend Oreille R.	A(C)	0.36	TSS, P
			R	0.20	P
4	Crow Cr.	Flathead R.	A(C)	0.52	TSS, N, P, Temp
			R	1.29	FC, P
			I	0.18	FC

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
5	Hot Springs Cr.	Little Bitterroot River	A(W)	1.73	N, P
			P	0.42	Ammonia
			R	2.33	P
6	Mission Cr.	Flathead R.	A(C)	0.55	TSS, N, P, Temp
			P	0.03	Ammonia
			R	2.19	FC, P
			I	0.30	FC
7	Post Cr.	Mission Cr.	A(C)	0.34	TSS, N, P
			R	1.76	FC, P, pH
			I	0.21	FC
8	Spring Cr. below Ronan	Crow Cr.	A(C)	2.14	N, P
			R	6.88	FC, P
			I	1.65	FC


CLARK
FORK
RIVER
Thompson Falls
5
River
Ronan
4
8
7
6
Flathead
N
CLARK FORK
3
RIVER
2
Missoula
1
0 10 20 30 40 Miles
LOWER CLARK FORK
RIVER BASIN
River
Bitterroot
Hamilton

4 - FLATHEAD RIVER BASIN

The Flathead River Basin drains much of northwestern Montana. It extends south from the Canadian border, west from the Continental Divide, north from the lower end of Flathead Lake and east from the Whitefish and Salish mountains.

The region is largely mountainous and forested, with timber harvest the principal industry and agriculture restricted to the mostly narrow valley bottoms. The one notable exception is the broad north-south trough that contains Flathead Lake and the agricultural/commercial heart of the basin: the Flathead Valley. Most of the basin is sparsely inhabited except for the area around Kalispell, which is at the center of one of the fastest growing regions of Montana.

Elevations in the drainage range from more than 10,000 feet in Glacier National Park to about 2,900 feet on Flathead Lake. The climate is moist and cool, influenced both by Pacific weather systems from the west and by the stabilizing effect of the 183 square mile Flathead Lake. Annual precipitation varies from over 50 inches in the mountains to about 20 inches in the Flathead Valley.

As a headwater drainage of the Clark Fork-Columbia River system, the Flathead has some of the purest waters in America. With few exceptions, waters in the basin are suitable for all beneficial uses following minimal treatment. Water quality problems are usually associated with surface disturbances, concentrations of livestock or people, and with large hydroelectric dams. Forestry and agriculture are the primary land-disturbing activities. Canadian coal development across the border in British Columbia portends water quality impacts on the North Fork of the Flathead River.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Ashley Cr. below Kalispell WWTP	Flathead R.	A(C)	1.90	NH_3, TSS, Temp, DO N, P
			R	1.90	P, FC
			P	0.19	NO_3, Ammonia
			I	1.96	FC
2	Stillwater R. below Logan Cr.	Flathead R.	A(C)	0.45	TSS, Temp, P
			R	0.51	P
3	Whitefish R. below Whitefish Lake	Stillwater R.	A(C)	0.52	TSS, Temp, NH_3, P
			R	0.93	P


CANADA
North Fork Flathead River
Middle Fork Flathead River
South Fork Flathead River
Whitefish
Columbia Falls
FLATHEAD RIVER
Kalispell
Flathead Lake
Polson
1
2
3
N
0 10 20 30 Miles
FLATHEAD RIVER BASIN

5 - ST. MARY RIVER BASIN

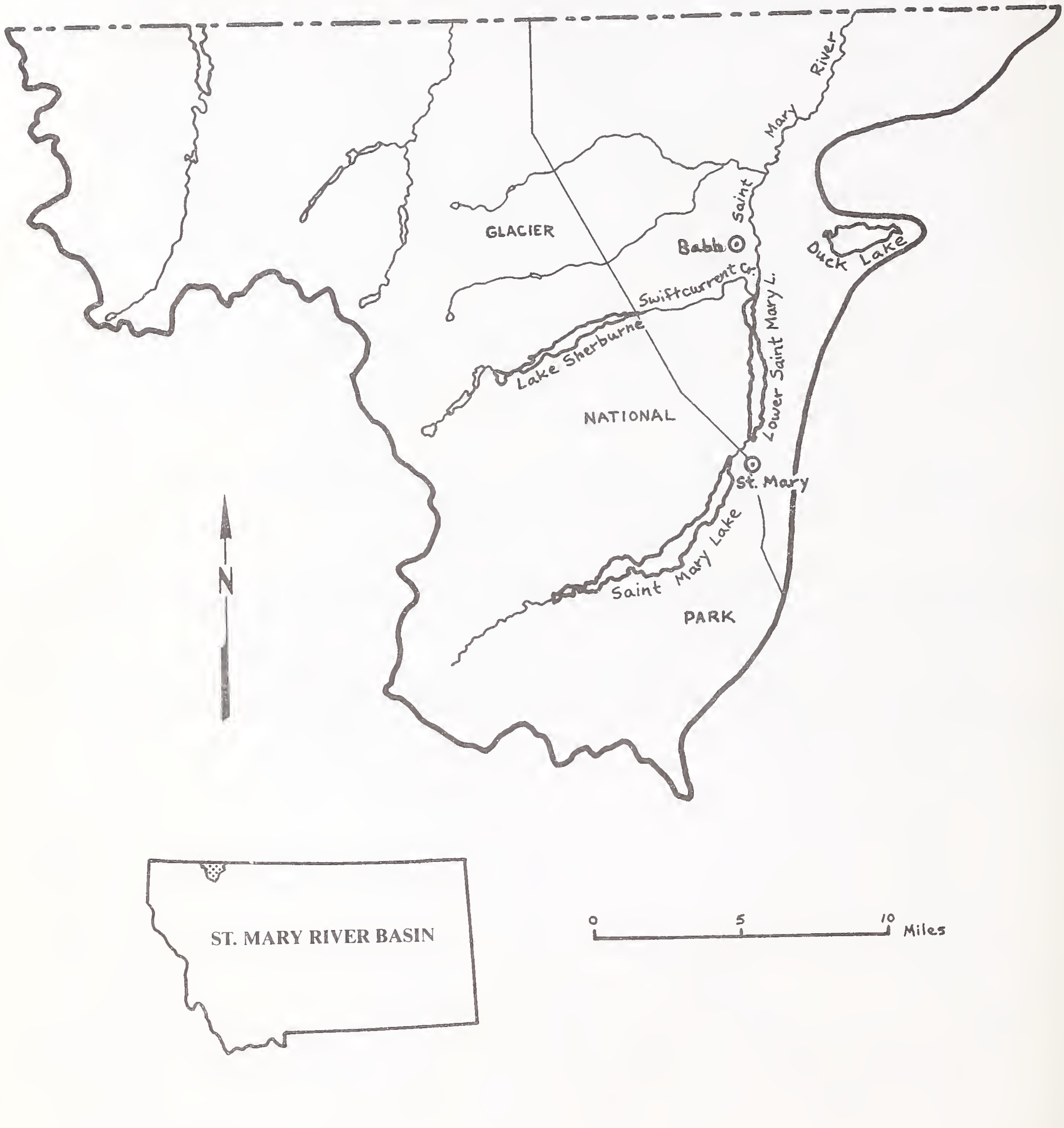
The St. Mary River Basin is less than one percent of the total land area in Montana. Seventy percent of the basin is in Glacier National Park and 30 percent on the Blackfeet Indian Reservation. The waters form the headwaters of Canada's Saskatchewan River system, which drains north and east to Hudson's Bay. Physical characteristics in the basin include the spectacular mountains, glaciers and glacial lakes in Glacier Park, forested hill terrain at lower elevations, and rolling rangeland in the St. Mary River Valley. Elevations in the drainage range from more than 10,000 feet in Glacier National Park to less than 4,500 feet at the international border. Climate is dependent on elevation. Rainfall varies from 120 inches a year in the mountains to 20 inches a year on the prairie. Temperature extremes are generally more pronounced at lower elevations, particularly under the influence of chinook winds in the winter.

The quality of waters in the St. Mary drainage basin is generally excellent. Population in the basin is sparse, and wastewater discharges few and minor. The primary land use outside Glacier Park is grazing and only a small fraction of the drainage is farmed. The two principal stream segments in the basin are the Belly and the St. Mary rivers.

The Belly River drainage in Montana is confined entirely to Glacier National Park. All waters in the drainage are nearly pristine, and suitable for most beneficial uses with little or no treatment.

The St. Mary River and its tributaries are classified as being drinkable after conventional treatment. Swiftcurrent Creek is seasonally dewatered and has been subject to hydrologic damage.

The post-1975 data available to the Water Quality Bureau on STORET indicate that there are no significant pollution problems in this basin that are predominantly man-caused.


Saint Mary River
GLACIER
NATIONAL
PARK
Babb
St. Mary
Swiftcurrent Cr.
Lake Sherburne
Lower Saint Mary L.
Saint Mary Lake
Duck Lake
N
ST. MARY RIVER BASIN
0
5
10
Miles

6 - UPPER MISSOURI RIVER BASIN

The upper Missouri Basin, which includes southwestern Montana and northwestern Yellowstone Park, is characterized by several large mountain ranges separated by broad agricultural valleys with extensive irrigation development. The basin is drained by the Gallatin, Madison and Jefferson rivers, which form the Missouri River near the town of Three Forks. These and other streams in the drainage are some of the most popular and productive cold-water fisheries in America.

Population in the basin is sparse and strongly tied to agriculture. However, aesthetic qualities have resulted in increased tourist trade and recreation-based industries, thus attracting new residents.

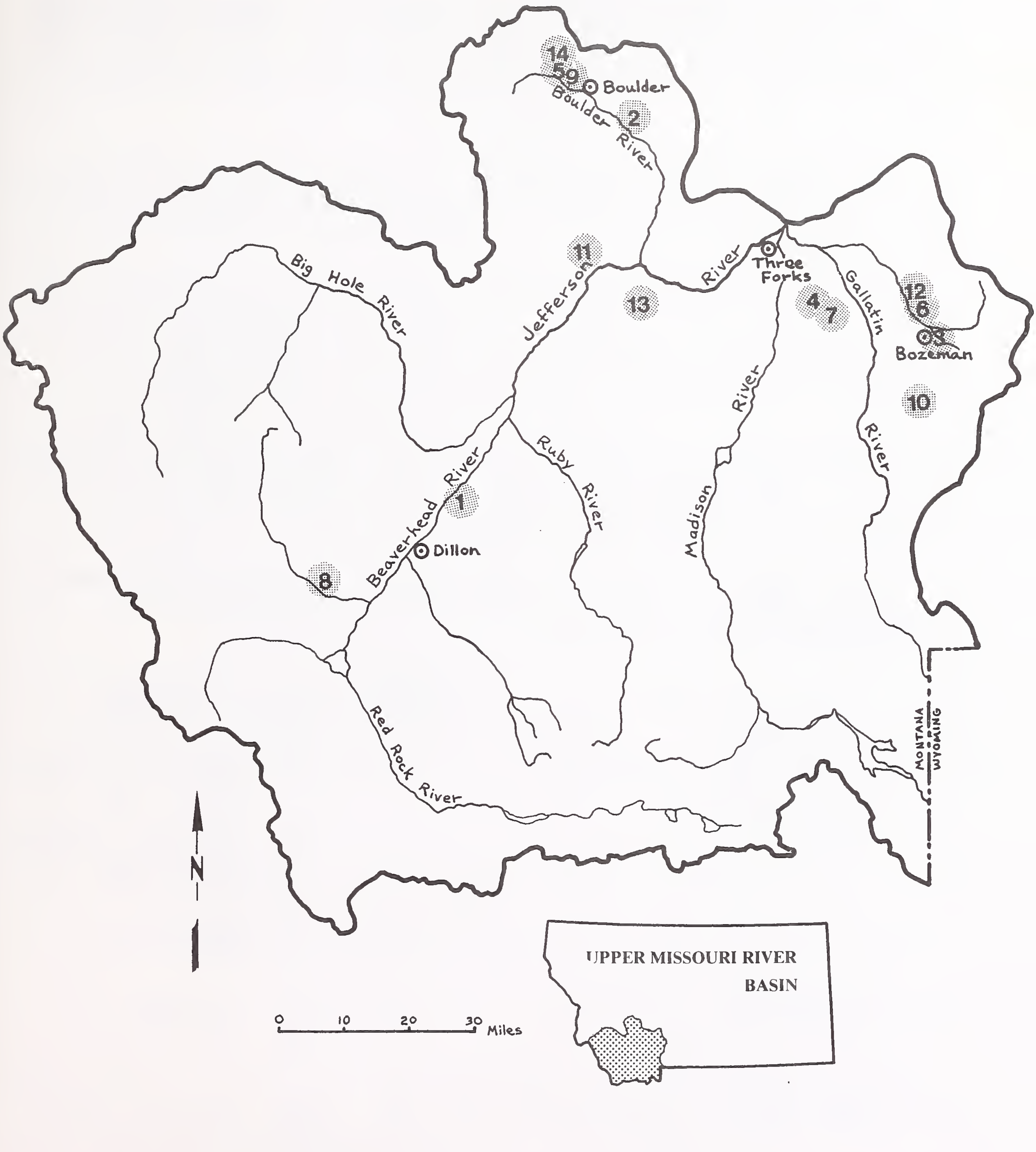
Elevations in the drainage range from over 11,000 feet in several of the mountain ranges to less than 4,500 feet at Three Forks. Valley precipitation is about 12 to 20 inches per year. Peak precipitation occurs in May and June followed by a lesser peak in September. Summers are generally warm and sunny; arctic cold-air masses sometimes settle in for several days during the winter, dropping temperatures well below zero.

Surface and groundwater quality is generally excellent, however, the basin also includes a nearly complete cross section of Montana water quality problems, such as sediment, temperature, dewatering, nutrients, coliforms, eutrophication and acid mine drainage. Quality typically degrades as water flows downstream, picking up salts, carrying higher nutrient loads and increasing in temperature. The numerous reservoirs in the basin tend to average flows and salt concentrations while causing deposition of sediment in slackwater areas and increased streambed erosion below dams.

The eight major rivers that make up the upper Missouri River Basin include: The Red Rock, Beaverhead, Ruby, Big Hole, Jefferson, Boulder, Madison and Gallatin rivers.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Beaverhead R. below Dillon	Jefferson R.	A(C)	0.40	Temp, P
			R	1.01	FC, pH
2	Boulder R. below Basin	Jefferson R.	A(C)	0.57	Iron, P, Zinc, Copper, Silver
			R	0.51	pH, P
3.	Bozeman Cr. below Bozeman	East Gallatin R.	A(C)	1.12	TSS, pH, N
			R	42.30	FC, pH
4	Camp Cr.	Gallatin R.	A(C)	2.49	TSS, pH, N
			R	14.57	FC, pH
			I	13.06	FC
5	Cataract Cr. below Eva May Mine	Boulder R.	A(C)	7.43	TSS, pH, Metals
			P	1.12	pH, Manganese
			R	1.05	pH

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
6	East Gallatin R.	Gallatin R.	A(C)	0.57	Temp, pH, N, P
			P	0.16	pH
			R	1.88	P, pH
7	Godfrey Cr.	Gallatin R.	A(C)	2.69	TSS, N, P, Iron
			P	1.40	Manganese
			R	2.36	pH, P
8	Grasshopper Cr. below Bannack	Beaverhead R.	A(C)	1.66	TSS, Cadmium, Copper
9	High Ore Cr. below Comet Mine	Boulder R.	A(C)	7.54	Metals
			P	13.19	Arsenic, Cadmium, Zinc
			I	17.99	Arsenic
			L	8.99	Arsenic
10	Hyalite Cr. below F.S. Boundary	East Gallatin R.	A(C)	0.54	TSS, pH, N
			R	13.68	FC, pH
11	Pipestone Cr.	Jefferson R.	A(C)	34.92	TSS, P, Iron
			P	2.60	Manganese
			R	1.90	P
12	Reese Cr.	East Gallatin R.	A(C)	1.78	TSS, pH, N
			R	38.18	FC, pH
13	South Boulder R. below Mammoth	Jefferson R.	A(C)	1.08	pH
			P	1.08	pH
			R	1.08	pH
14	Uncle Sam Gulch below Crystal Mine	Cataract Cr.	A(C)	14.73	pH, Zinc, Cadmium, Copper
			P	3.16	pH, Cadmium, Manganese
			R	1.09	pH


14
5 9
Boulder
Boulder River
2
Big Hole River
11
Jefferson
13
River
Three Forks
Gallatin River
12
6
3
Bozeman
4
7
10
Madison River
Ruby River
Beaverhead River
1
Dillon
8
Red Rock River
MONTANA
WYOMING
N
0
10
20
30
Miles
UPPER MISSOURI RIVER
BASIN

7 - MISSOURI-SUN-SMITH RIVER BASIN

This basin includes all lands drained by a 250-mile stretch of the Missouri River in westcentral Montana from the three forks of the Missouri River to the mouth of the Marias River at Loma. Total drainage area is approximately 11,000 square miles or 7 million acres. Topography in the basin varies from mountainous to rolling plains. The lowest point in the basin is less than 3,000 feet at Loma.

The semi-arid climate of the valleys and rolling plains is typified by cold, dry winters, moist springs and warm, dry summers. Annual precipitation in these areas usually ranges from 10 to 15 inches. Mountain areas, particularly along the Continental Divide, receive significant snowfall during the winter.

Agriculture is the leading industry in the basin and livestock production is the major agricultural operation. Irrigated lands account for 280,000 acres and dry croplands cover an additional 900,000 acres. Two-thirds of the area is in private ownership or other non-federal control and is used primarily for range or crops. Management of the federal third is largely for grazing and forest use by the U.S. Forest Service and the Bureau of Land Management.

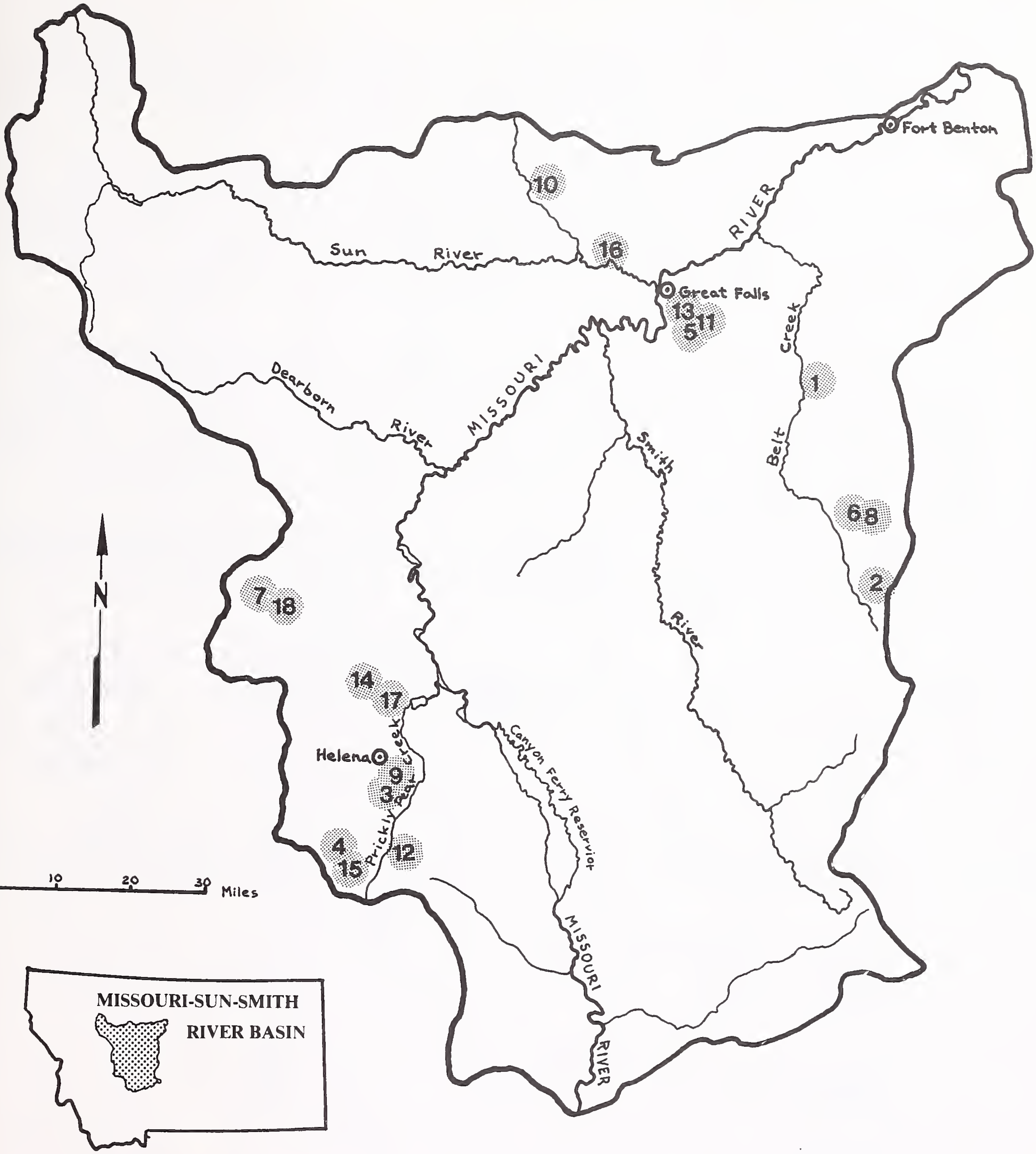
Irrigation is the predominant consumptive use of water in the drainage, consuming an estimated 295,000 acre-feet annually. There are 17 reservoirs and run-of-river impoundments within the basin having at least 1,000 acre-feet of storage each. The three largest are Canyon Ferry and Holter, both on the Missouri River, and Gibson on the Sun River.

Water quality in the basin runs the gamut from the some of best to some of the worst in the state. There are several municipal, agricultural, and industrial discharges in the basin.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Belt Cr. below Dry Fork Belt Cr.	Missouri R.	A(C)	5.28	TSS, Temp, P, Silver Copper, Iron, Lead, Zinc, Cadmium
			P	2.57	Manganese, Chromium, Nickel, Lead, Silver Cadmium
			R	0.29	P
			I	0.23	Iron
			L	0.52	Lead
2	Carpenter Cr.	Belt Cr.	A(C)	1.47	pH, Zinc
			P	1.17	pH, Nickel
			R	1.05	pH
3	Clancy Cr.	Prickly Pear Cr.	A(C)	0.74	TSS, P, Iron, Copper
			P	0.96	Manganese, Lead
			R	0.87	P
4	Corbin Cr.	Spring Cr.	A(C)	22.42	TSS, pH, Iron, Cadmium, Copper, Zinc

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
			P	18.34	pH, SO_4, Iron, Cadmium, Manganese, Copper
			R	0.60	pH
			I	1.25	pH, TDS, Iron
			L	4.75	Copper
5	Cottonwood Cr.	Sand Coulee Cr.	A(C)	2.17	pH, Metals
			P	13.33	pH, Manganese, Zinc
			R	2.17	pH
			I	1.61	pH, Zinc
6	Dry Fork Belt Cr.	Belt Cr.	A(C)	2.93	Iron, Zinc, Copper, Silver, Cadmium
			P	14.87	Iron, Manganese
7	Fool Hen Cr.	Virginia Cr.	A(C)	7.90	TSS, Iron, Cadmium, Zinc, Copper
			P	1.50	Lead
			L	0.75	Lead
8	Galena Cr.	Dry Fork Belt Cr.	A(C)	7.60	TSS, Iron, Zinc, Copper, Silver, Cadmium
			P	21.76	Iron, Manganese, Zinc, Cadmium
9	Lump Gulch Cr.	Prickly Pear Cr.	A(C)	0.17	TSS, Iron
			P	0.92	Manganese
10	Muddy Creek	Sun R.	A(C)	16.85	TSS, Temp, N, P
			P	0.40	TDS, SO_4
			R	1.50	pH, P
			I	0.02	TDS, Sodium
11	Number Five Coulee	Sand Coulee Cr.	A(C)	5.48	TSS, Iron
12	Prickly Pear Cr. below Spring Cr.	Missouri R.	A(C)	2.93	TSS, NH_3, Arsenic, Cadmium
			P	4.57	Arsenic, Lead, Manganese, Selenium
			R	5.01	FC, P
			I	3.82	FC, pH, Arsenic, Selenium, Cadmium
			L	0.76	Lead, Arsenic, Cadmium, Selenium
13	Sand Coulee Cr.	Missouri R.	A(C)	2.02	pH, Metals
			P	22.56	pH, Manganese, Zinc
			R	2.02	pH
			I	1.58	pH, Zinc

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
14	Silver Cr.	Prickly Pear Cr.	A(C)	0.67	Copper, Silver, Mercury
			P	0.63	Mercury, Cyanide
15	Spring Cr. below Crobin Cr.	Prickly Pear Cr.	A(C)	9.58	TSS, pH, P, Iron, Zinc, Copper, Cadmium
			P	2.12	pH, Iron, Lead, Zinc, Copper, Arsenic, Cadmium, Manganese
			R	0.10	pH, P
			I	0.26	pH, Iron, Zinc, Cadmium
			L	0.56	Lead, Copper, Cadmium
16	Sun R. below Muddy Cr.	Missouri R.	A(W)	0.62	TSS, N, P
			P	0.34	TDS, SO_4
			R	0.52	P
17	Tenmile Cr.	Prickly Pear Cr.	A(C)	1.86	pH, Iron, Zinc, Copper
			P	2.10	pH, Iron, Arsenic, Manganese
			R	0.26	pH
18	Virginia Cr. below Fool Hen Cr.	Canyon Cr.	A(C)	2.48	TSS, Lead, Zinc, Cadmium, Copper
			P	2.33	Lead
			L	1.17	Lead


Fort Benton
Sun River
RIVER
Great Falls
Dearborn River
MISSOURI
Smith River
Belt Creek
N
Helena
Prickly Pear Creek
Canyon Ferry Reservoir
MISSOURI RIVER
0 10 20 30 Miles
MISSOURI-SUN-SMITH RIVER BASIN
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

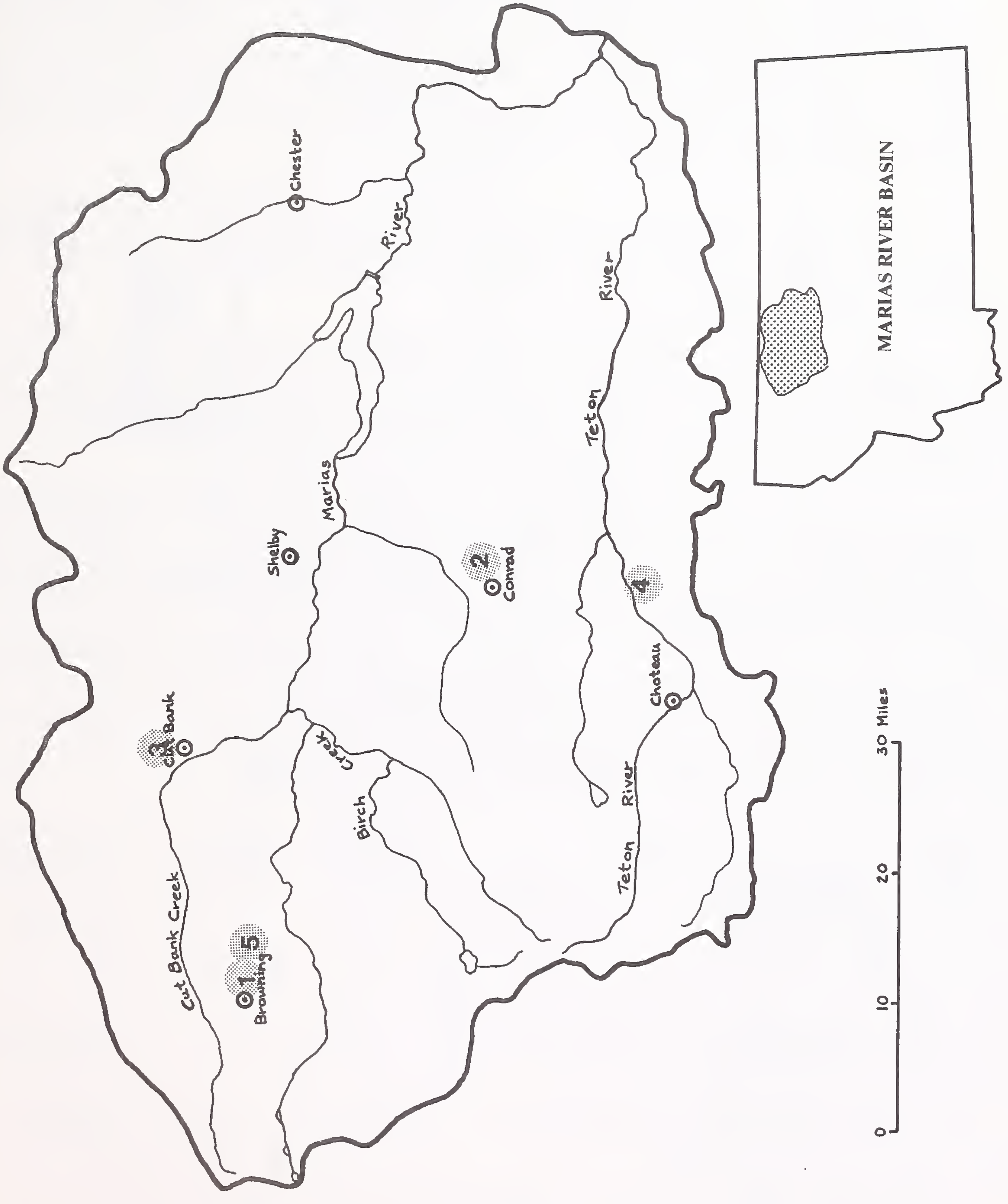
The headwaters of the Marias River are along the east slope of Glacier Park. From the Continental Divide the river flows through the mountains and rolling agricultural country in northcentral Montana to the Missouri River below Fort Benton. The basin drains approximately 9,100 square miles.

The Marias basin is characterized by hot, dry summers and cold, dry winters. A large portion of the annual precipitation occurs in the spring. Precipitation ranges from 10 to over 30 inches per year, the latter falling in the mountains. Mean monthly temperatures range from -2 degrees F in January to 83 degrees F in July. Wind is a persistent feature of the basin's climate; frequent warm, dry chinook winds may cause rapid snowmelt and flooding.

About 62 percent of basin lands are used for pasture and range. Croplands comprise 31 percent of the total area; 2 percent is under irrigation and 29 percent is dryland. Irrigated agriculture is the largest water user in the basin, annually diverting approximately 780,500 acre-feet. The major irrigated crop is hay. Forest and woodlands occupy the remaining 7 percent of the basin. Oil and gas production occurs throughout the basin. The urban population is small; only about 15,000 people live in the nine largest communities.

The principal rivers are the Marias and the Teton. Water quality is good to excellent in the western headwaters region, but degrades as the rivers flow from west to east. The predominant pollutants are sediment and salt.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Depot Cr. below Browning WWTP	Willow Cr.	A(C)	9.80	NH_3, pH, N, P
			P	2.10	pH, Ammonia
			R	16.52	pH, P
2	Dry Fork Marias R. below Conrad WWTP	Marias R.	A(W)	0.12	Temp
			P	0.73	TDS, SO_4, pH
			R	0.85	FC, pH
3	Old Maid's Coulee below Cut Bank WWTP	Cut Bank Cr.	A(C)	8.20	N, P
			P	1.40	Ammonia
			R	15.00	P
			I	1.21	TDS
4	Teton R. below Priest Butte Lakes	Marias R.	P	4.40	SO_4
			I	1.56	TDS, Sodium
5	Willow Cr. below Depot Cr.	Cut Bank Cr.	A(C)	3.04	pH, DO, N, P
			P	0.66	pH, Ammonia
			R	4.56	pH, P


Chester
Marias
River
Shelby
2
Conrad
4
Teton
River
Choteau
3
Cut Bank
Birch
Creek
Teton
River
Cut Bank Creek
5
1
Browning
MARIAS RIVER BASIN
0
10
20
30 Miles
N

9 - MIDDLE MISSOURI RIVER BASIN

The middle Missouri River Basin has as its axis the 275 miles of the Missouri River that flows from Fort Benton to the Fort Peck Dam.

The upper third of the basin is rolling, relatively roadless prairie, broken by the spectacular and rugged white cliffs of the Missouri River Breaks, with the Bear Paw Mountains looming to the north. The middle stretch flows under the Fred Robinson Bridge, the only bridge between Fort Benton and Fort Peck Dam, east through the Charles M. Russell Wildlife Refuge where cattle and wildlife graze on rough, prairie land. The lower third of the basin encompasses the sprawling Fort Peck Reservoir, which is surrounded by the refuge and "badlands."

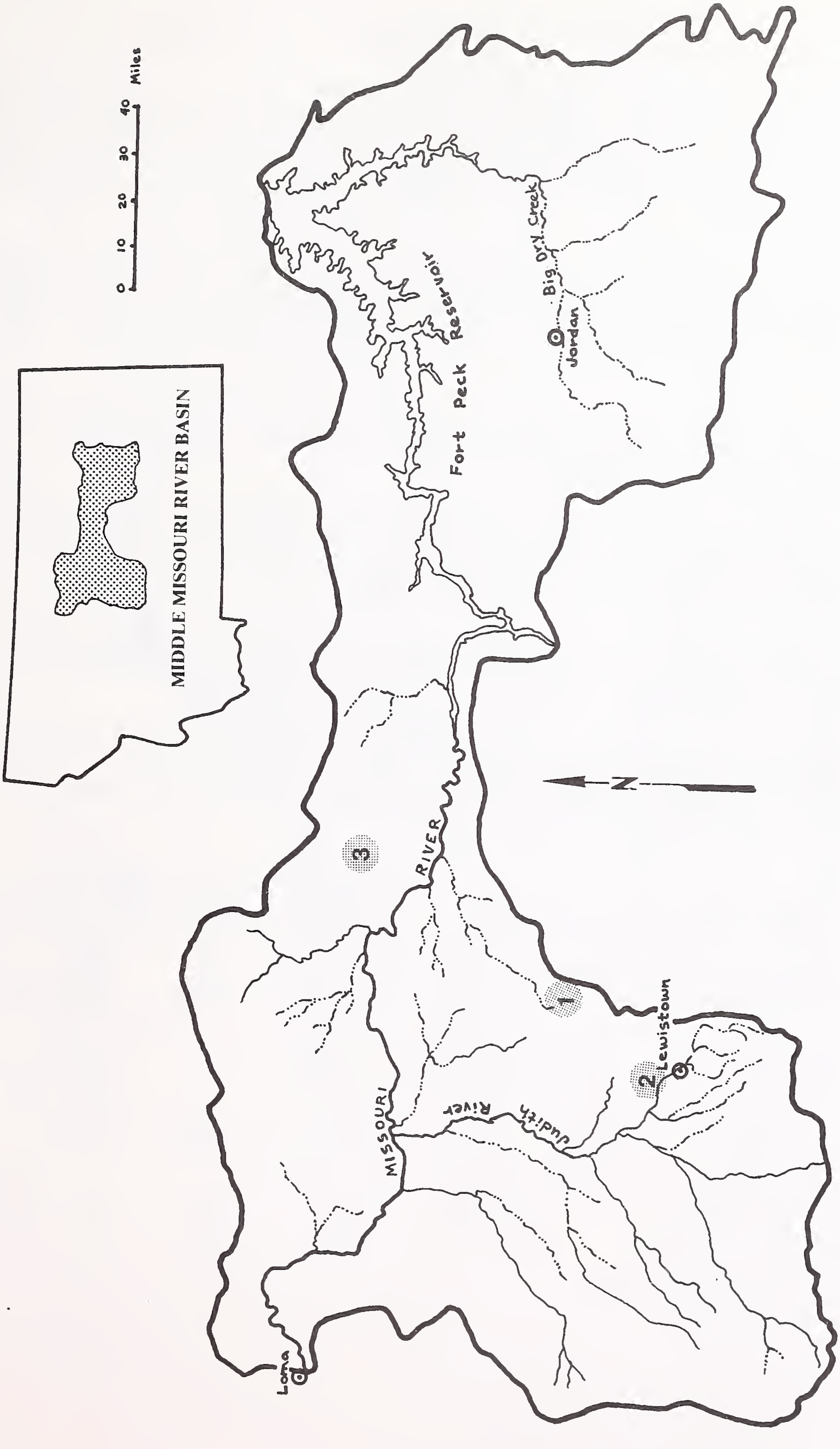
The basin is typified by low annual rainfall and temperature extremes. Annual precipitation averages between 11 and 15 inches, with June the wettest month. Snowmelt from the minor mountain ranges that dot the area add to flows between April and June.

The only major population center is Lewistown, with fewer than 10,000 residents. The western part of the basin has a greater percentage of grain-growing land, while the east has more rangeland, which is the largest land use in the basin. The largest water use in the basin is for irrigation, diverting approximately a quarter-million acre-feet annually.

The basin has substantial energy resources in the form of petroleum and coal. There is continuing petroleum exploration and production, but it has had little impact on water quality. There are large deposits of strippable coal in the southern and eastern portions of the basin. These have yet to be developed, but could result in coal mining and synthetic fuel production.

The basin contains only a few municipal and two industrial dischargers and several feedlots. However, natural sediment and salts, amplified by agricultural practices, are the dominant spoilers of the basin's water quality. These pollutants emanate from irrigation returns, poor soil conservation practices, saline seep, overgrazing and natural erosion.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Armells Cr.	Missouri R.	A(C)	0.50	pH, Iron
			P	2.48	pH, Iron
			R	0.48	pH
2	Big Spring Cr. below Lewistown WWTP	Judith R.	A(C)	0.43	NH_3, pH, TSS, N, P
				R	0.18 pH, P
3	Montana Gulch	Missouri R.	A(C)	7.66	Iron, Zinc
			P	1.00	Arsenic


MIDDLE MISSOURI RIVER BASIN
0 10 20 30 40 Miles
Fort Peck Reservoir
Big Dry Creek
Jordan
N
RIVER
MISSOURI
Judith River
Lewistown
Loma
1
2
3

10 - MUSSELSHELL RIVER BASIN

The Musselshell River originates at the confluence of its north and south forks east of Martinsdale. From its origin in the Little Belt Mountains, the river flows in an easterly direction for 125 miles along the southern flank of the Big Snowy Mountains. The river then heads north for 55 miles to Fort Peck Reservoir. The Musselshell and its tributaries drain an area of approximately 8,000 square miles.

The basin terrain generally may be described as hilly. Soils in the basin are as varied as the physiographic features. The valley of the Musselshell, which contains the basin's more desirable farmland, is less than a mile wide and is bordered by sandstone rimrocks and rugged shaly breaks along most of its course.

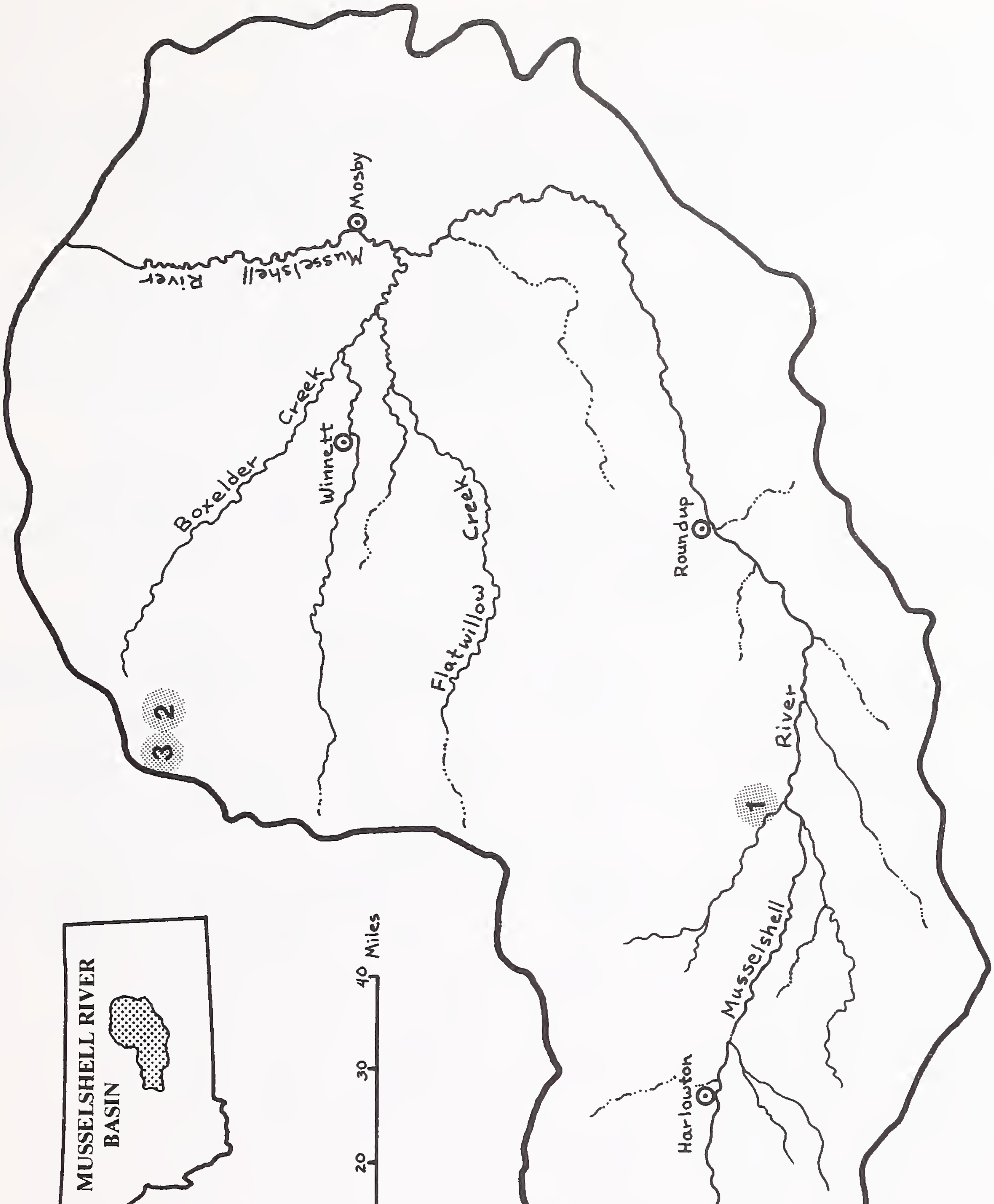
The Fort Union coal formation is present in the central portion of the basin near Roundup. The formation contains commercial coal beds under development southeast of Roundup.

The Musselshell Basin is best described as a semi-arid region with a short growing season. Average annual precipitation is around 12.5 inches. Forty to fifty percent falls in the spring, with June the wettest month. The various mountain ranges contribute some snowmelt runoff.

The basin is rural. The largest land use is privately owned rangeland, comprising 67 percent of the basin. Irrigation is the basin's largest water consumer, diverting nearly one-half million acre-feet annually.

Water quality problems in the basin are predominately natural; some are aggravated by logging and agriculture. Some saline seep occurs. The quality of Musselshell water becomes more and more degraded, due to sediment and salts, as it travels toward the Fort Peck Reservoir.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Careless Cr. below Deadmans Canal	Musselshell R.	A(W)	0.92	TSS, P, Iron
			P	2.18	TDS, SO_4, Manganese
			I	0.64	TDS, Sodium
2	Chicago Gulch	Box Elder Cr.	A(C)	1.77	pH, Iron, Zinc, Cadmium
			P	1.59	pH, Lead
			R	1.18	pH
3	Coller Gulch	Box Elder Cr.	A(C)	2.16	Lead, Zinc
			P	3.02	pH, Lead
			R	1.05	pH
			L	2.50	Lead


MUSSELSHELL RIVER BASIN
Mosby
Musselshell River
Boxelder Creek
Winnett
Flatwillow Creek
Roundup
Musselshell River
Harlowton
1
2
3
0 10 20 30 40 Miles
N

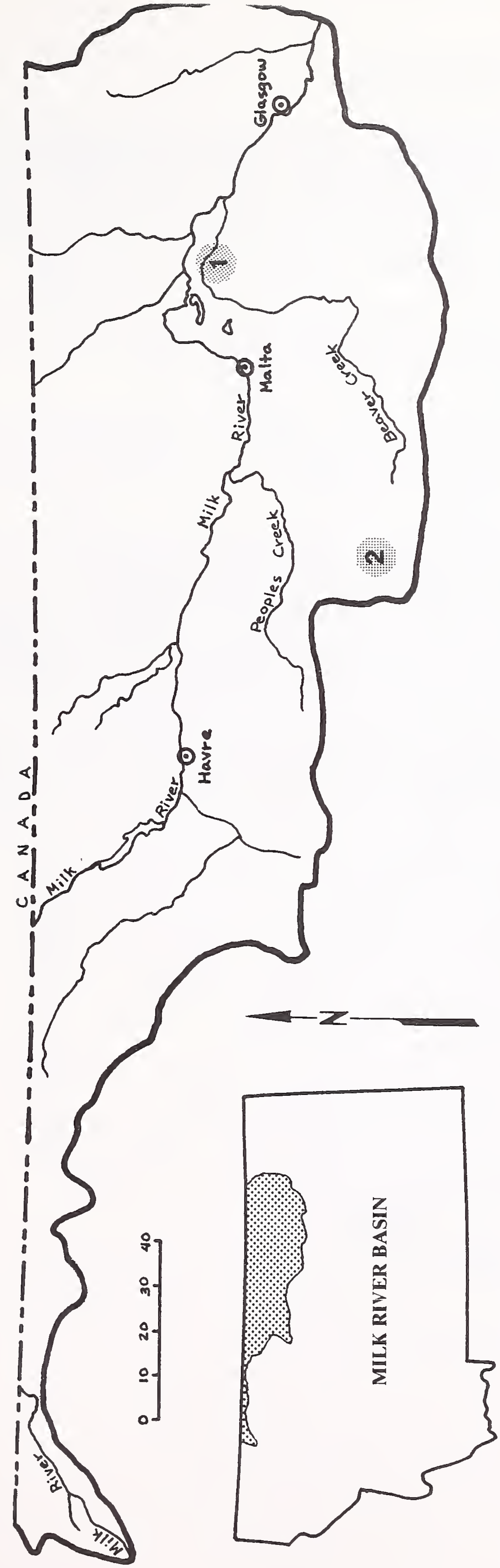
11 - MILK RIVER BASIN

The Milk River originates in Glacier National Park, flows into Canada, then re-enters the U.S. and heads east to its confluence with the Missouri River below Fort Peck Dam. The basin drains about 15,000 square miles. The major geologic event that influenced soils of the Milk River Basin was continental glaciation, which resulted in the filling of many stream valleys with alluvium.

The largest land use in the basin is privately owned rangeland, constituting about 45 percent of the total land area. The next largest is federal forest and rangeland, which accounts for about 28 percent. Cropland takes up about 23 percent, mostly in dryland grain production in the western half of the basin. Irrigation is the largest water user, diverting about 1.5 million acre-feet annually.

There are several industrial and agriculture waste discharges and at least a dozen municipal waste discharges. Sediment and salts are the major despoilers of basin waters. The sources include poor grazing and cropping practices, irrigation returns and saline seeps.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Beaver Cr. below Lake Bowdoin	Milk R.	A(W)	2.05	TSS, P
			P	1.63	TDS, SO_4
			R	1.98	P
			I	0.55	TDS, Sodium
2	Little Peoples Cr.	Peoples Cr.	A(C)	0.42	TSS, Cadmium
			P	0.19	Lead, Cadmium, Nickel
			L	0.12	Lead


CANADA
Glasgow
Malta
Havre
Milk River
Milk River
Milk River
Beaver Creek
Peoples Creek
1
2
N
0 10 20 30 40
MILK RIVER BASIN

12 - LOWER MISSOURI RIVER BASIN

The lower Missouri River runs from below Fort Peck Dam to the Montana-North Dakota boundary. The basin has a total area of about 10,000 square miles with elevations ranging from 3,500 feet in the Big Sheep Mountains to 1,900 feet at the North Dakota border. Topography varies between rolling hills and flat plains that are occasionally cut by stream valleys, sometimes forming badlands-type pinnacles, bluffs and steep banks.

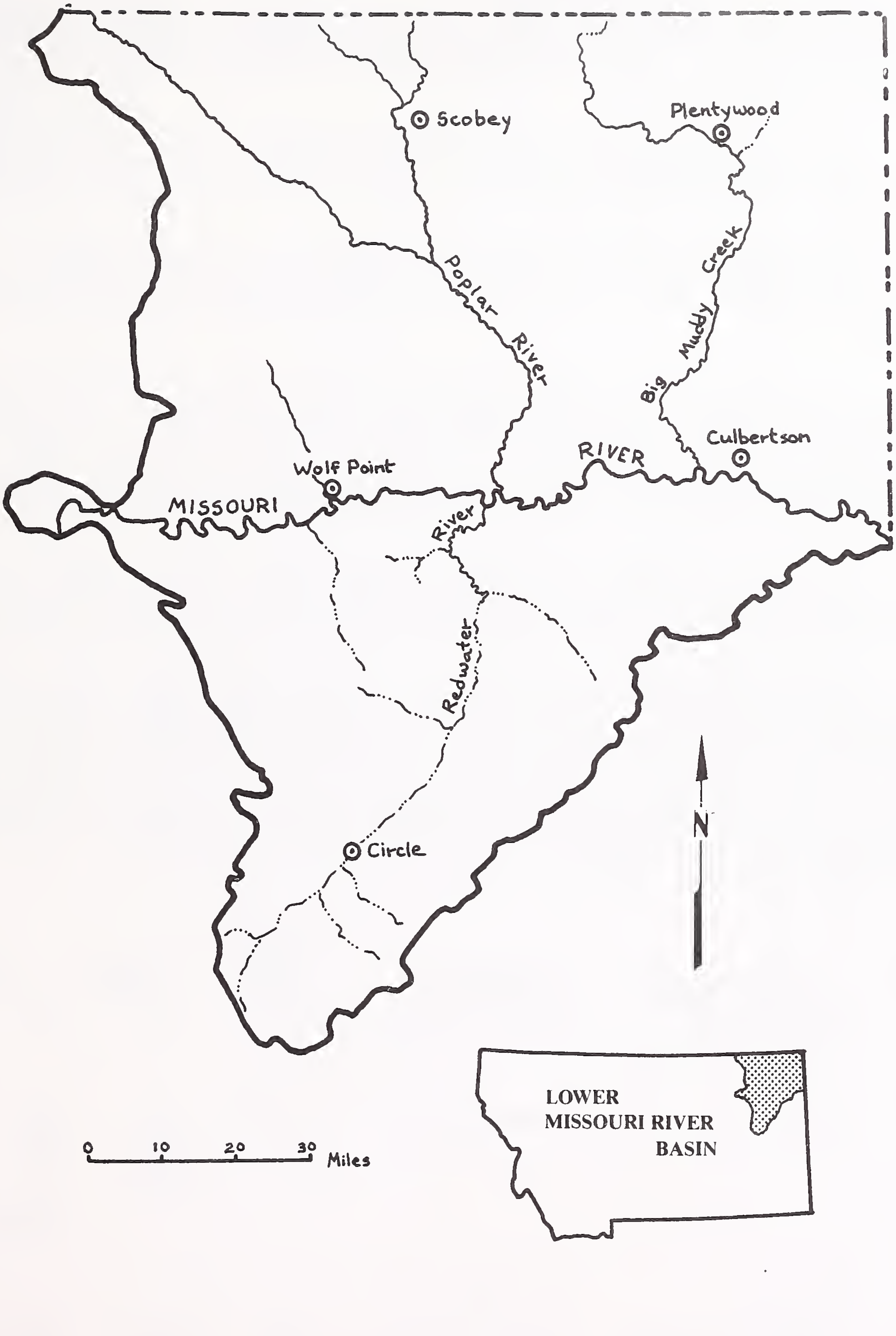
A continental type climate is typical for the basin. Winters are cold, summers are warm and springs are wet. Precipitation varies from 10 to 14 inches in the western portion to about 17 inches annually in the east.

The largest land use in the basin is privately owned rangeland, which constitutes about 40 percent of the total land area. The next largest is cropland at about 33 percent. State and federal rangeland make up about 19 percent of the land area.

The largest town is Wolf Point, with about 3,000 residents. There remains a vast amount of strippable coal under the southern part of the basin. Oil and gas development in the Williston Basin have recently stimulated growth in the area. The largest water use in the Lower Missouri Basin is irrigation, diverting about 270,000 acre-feet annually.

Natural waters of the basin generally are of only fair quality, being high in sodium and sulfates and providing warm-water habitats for aquatic life.

The post-1975 data available to the Water Quality Bureau on STORET indicate that there are no significant pollution problems in this basin that are predominantly man-caused.


Scobey
Plentywood
Poplar River
Big Muddy Creek
Culbertson
RIVER
Wolf Point
MISSOURI
River
Redwater
Circle
N
0 10 20 30 Miles
LOWER
MISSOURI RIVER
BASIN

13 - UPPER YELLOWSTONE RIVER BASIN

The upper Yellowstone River Basin in southcentral Montana encompasses the eastern slopes of the Rocky Mountains and the western edge of the Great Plains. Elevations descend from 12,799 feet (Granite Peak--the highest point in Montana) down to 3,300 feet.

The Montana portion of the basin is drained by the Yellowstone River and all of its tributaries from the state line in Yellowstone National Park to below the mouth of the Clark's Fork.

The Clark's Fork River Valley near Belfry is the driest part of the basin and one of the driest in Montana. The average annual precipitation there is only about six inches. Precipitation in the mountains is up to 35 inches per year.

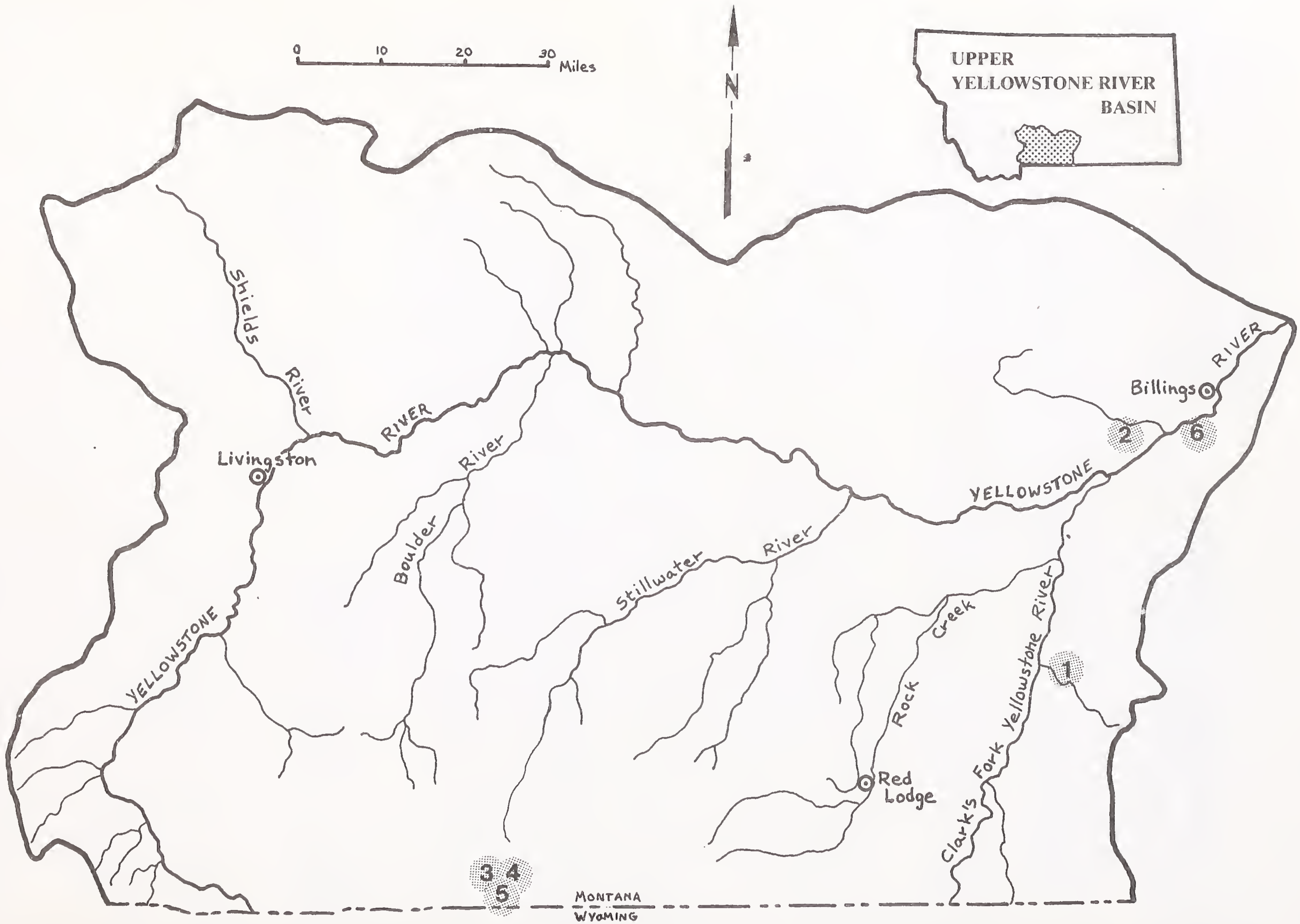
More than 100,000 people live in the basin, most of them in Billings. This is the largest urban and industrial center in Montana. The Billings area has three petroleum refineries, two major municipal wastewater discharges, a sugar beet refinery and a power plant with a heated discharge. However, agriculture is still the area's predominant economic activity. The largest water user is irrigation, depleting almost 800,000 acre-feet per year.

About 30 percent of the basin is forest land. Much of the basin offers recreational opportunities, including 95 miles of "blue ribbon" trout fishing on the Yellowstone River from Yellowstone Park to near the town of Big Timber.

Except for acid-mine drainage in certain tributaries, water quality in headwater streams near Yellowstone Park is excellent. The mainstem and larger tributaries pick up dissolved solids and suspended sediment as they proceed downstream. They also become warmer. The Clark's Fork of the Yellowstone is unique among the major tributaries in that it has only fair to poor water quality due to high turbidity and sediment loads. The segment of the Yellowstone near the mouth of the Clark's Fork is a transition zone between cold and warm-water aquatic life.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Bluewater Cr. below Orchard Canal	Clark's Fork R.	A(C)	3.25	TSS
2	Canyon Cr.	Yellowstone R.	A(C)	5.48	TSS, Temp, N, P
			P	2.08	TDS, SO_4
			R	0.54	P
			I	0.72	TDS, Magnesium, Sodium
3	Daisy Cr.	Stillwater R.	?	?	?
4	Fisher Cr. below Glengary Mine	Clark's Fork R.	A(C)	53.11	pH, Copper
			P	1.64	pH, Copper
			R	2.04	pH
			I	1.42	pH
			L	2.50	Copper

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
5	Soda Butte Cr. below McLaren Tailings	Lamar R.	A(C)	2.93	Iron
			P	9.77	Iron
6	Yellowstone R., Laurel to Huntley	Missouri R.	A(C)	1.56	TSS, Temp, Iron, P
			P	0.87	Manganese
			R	0.62	FC, pH, P


UPPER
YELLOWSTONE RIVER
BASIN
N
0
10
20
30
Miles
Shields
River
RIVER
Livingston
Boulder
River
YELLOWSTONE
Stillwater
River
YELLOWSTONE
RIVER
Billings
Rock
Creek
Red
Lodge
Clark's
Fork
Yellowstone
River
1
2
3
4
5
6
MONTANA
WYOMING

The middle Yellowstone Basin is on the western edge of the Great Plains. It includes the Yellowstone River and all of its tributaries from the confluence of Pryor Creek at Huntley to the confluence of the Tongue River at Miles City.

The basin is generally an area of rolling hills with gentle to moderate relief. The Bighorn Mountains spread into the southwest portion of the basin, giving that area a mountainous character. The basin drains 10,600 square miles.

Some of the soils in the basin are poorly drained and have a high salt content. The mountains bordering the basin create a moisture shadow. Sufficient snow falls in the mountains to give distinct runoff periods in the spring. Average annual precipitation for the basin is 11 to 16 inches, mostly falling in late spring and early summer.

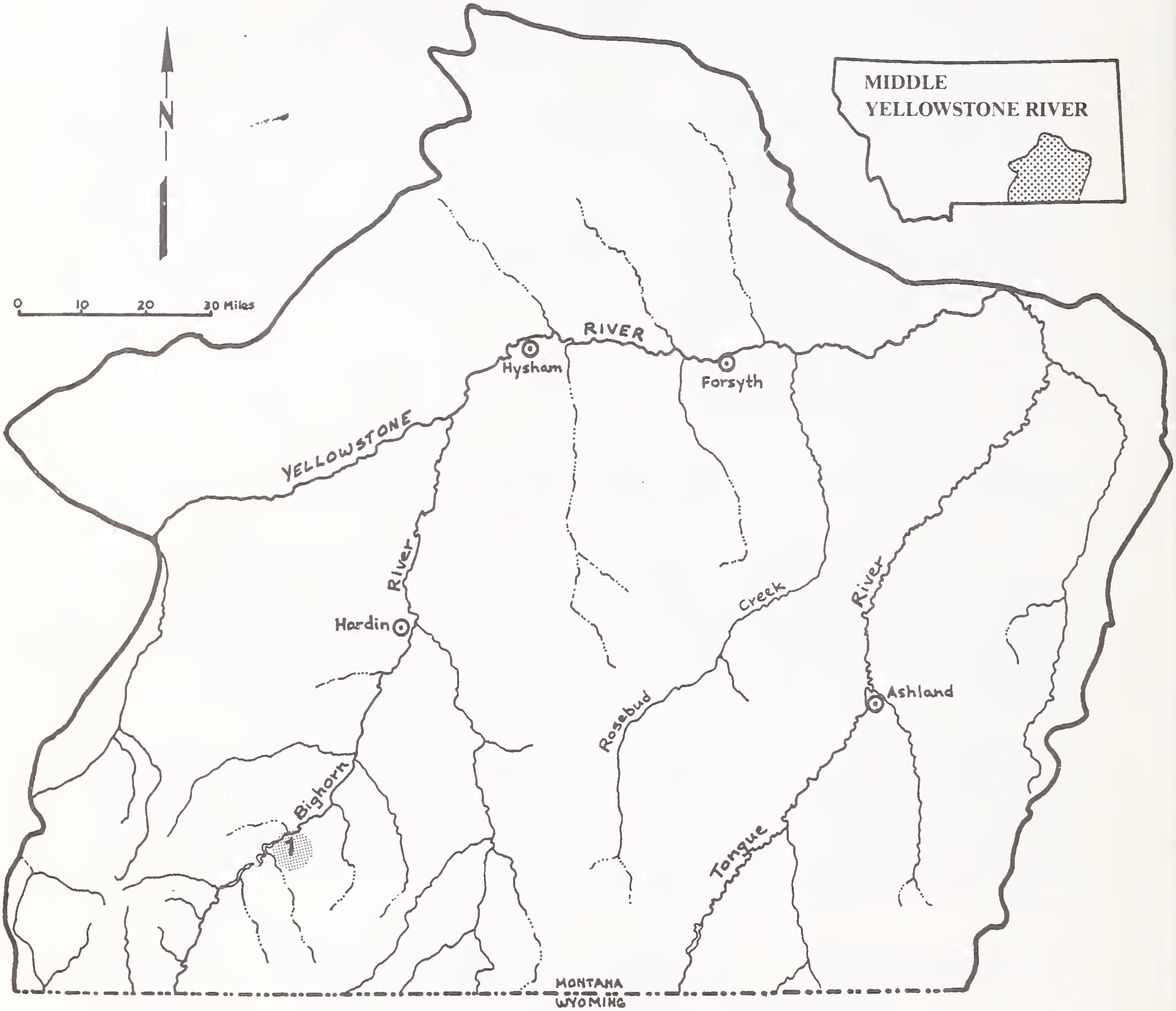
About 75 percent of the basin's land is used for pasture and range. Forests occupy about 7 percent.

More than 90 percent of Montana's coal production occurs in this basin. Underlying the basin is the Fort Union Formation, which contains a large percentage of the strippable coal in the United States.

Irrigated agriculture is the primary water user, depleting more than one-half million acre-feet per year. Industrial use has been negligible, but increasing and largely speculative demands for water have been made by energy concerns for power plants, coal-conversion facilities and coal-slurry pipelines. Increased coal and energy production would also bring about a large increase in population.

Water quality generally declines from southwest to northeast through the basin as streams warm and pick up dissolved and suspended materials. Quality is best in the headwaters of the larger tributaries on the south side of the Yellowstone and worst in smaller tributaries heading closer to the mainstem. Most streams support warm-water fisheries except portions of the Bighorn, Rosebud Creek and Tongue River drainages.

Map No.	Stream Segment	Drainage	Probable Impaired Uses	Severity Index	Problem Parameters
1	Bighorn R. below Yellowtail Dam	Yellowstone R.	A(C)	2.32	Gases, pH, P, Iron, TSS, Temp
			P	0.68	TDS, SO_4, pH, Iron, Manganese
			R	0.37	pH, FC, P


MIDDLE
YELLOWSTONE RIVER
N
0 10 20 30 Miles
RIVER
Hysham
Forsyth
YELLOWSTONE
River
Hardin
Creek
River
Ashland
Rosebud
Bighorn
1
Tongue
MONTANA
WYOMING

15 - LOWER YELLOWSTONE RIVER BASIN

The lower Yellowstone River Basin includes the Yellowstone River and all of its tributaries from Miles City (excluding the Tongue River) to the North Dakota border. With the exception of the Powder and Yellowstone rivers, most streams in this basin are small and many have intermittent flows. The basin drains about 11,650 square miles, an area of sparsely forested rolling hills and prairie grasslands.

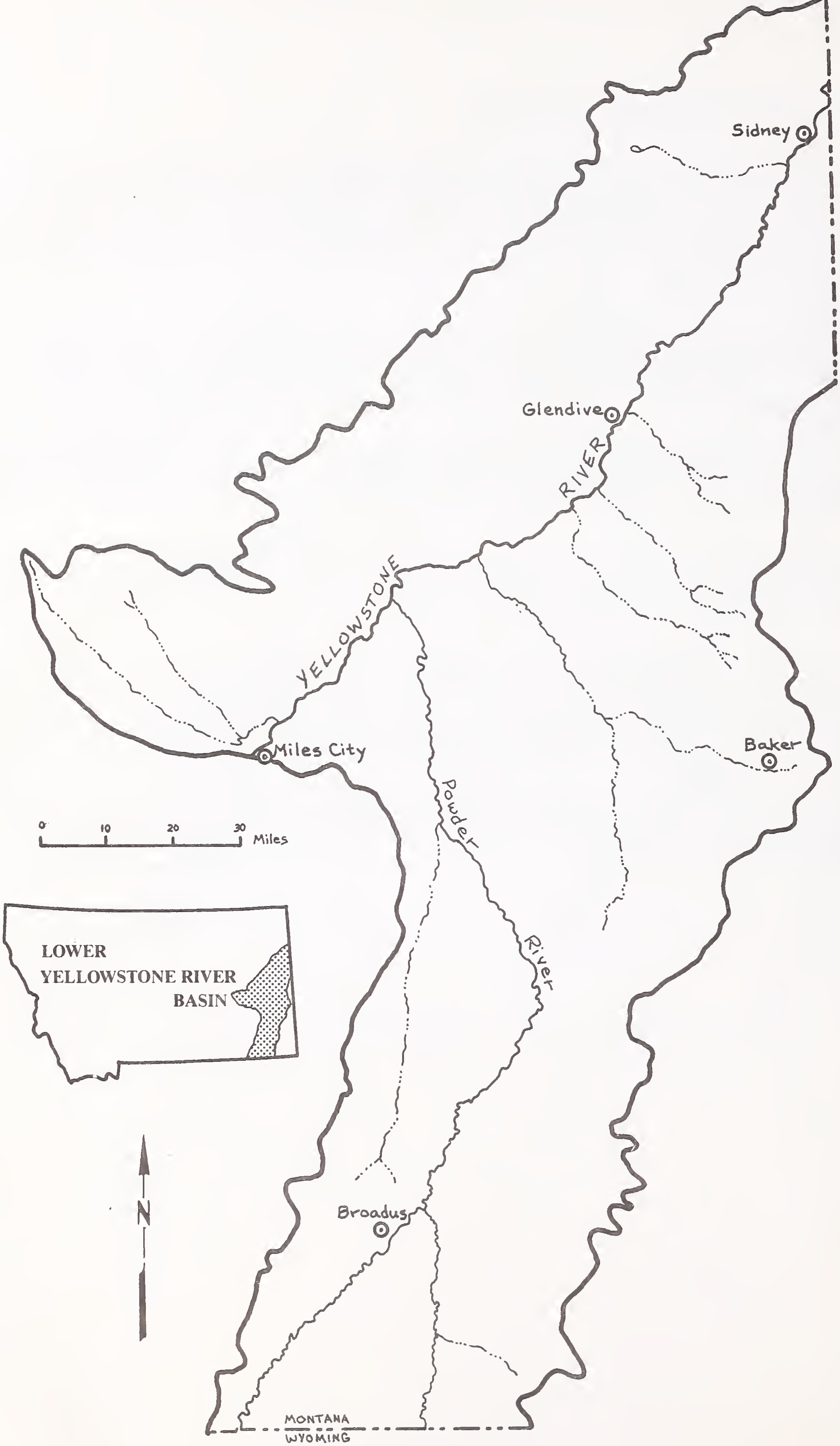
Elevations in the basin range from 2,000 to 5,000 feet. The basin's climate is typical of the semi-arid Northern Great Plains, with dry, cold winters, warm summers, variable rainfall and low humidity. June is usually the wettest month and average annual precipitation ranges between 12 and 14 inches.

Sixty-two percent of the basin is rangeland and used for livestock grazing. Cropland takes up only 15 percent of the basin and only 12 percent of that is irrigated, mostly along the Yellowstone River. The basin is largely rural.

The primary water use is for irrigation to produce hay. At least 750,000 acre-feet of water a year is diverted, with about 185,000 acre-feet consumed or depleted. Water use will increase as coal reserves are developed. The Fort Union Formation lies under part of the basin.

With the exception of the Yellowstone River and one or two others, streams in the basin have naturally poor quality water because of high sediment loads and large concentrations of salts. One stream, the Powder River, had been described as "a mile wide and an inch deep, too thick to drink and too thin to plow." Most streams in the basin support warm-water aquatic life.

The post-1975 data available to the Water Quality Bureau on STORET indicate that there are no significant pollution problems in this basin that are predominantly man-caused.


Sidney
Glendive
YELLOWSTONE
RIVER
Miles City
Baker
Powder
River
Broadus
0
10
20
30
Miles
LOWER
YELLOWSTONE RIVER
BASIN
N
MONTANA
WYOMING

16 - LITTLE MISSOURI RIVER BASIN

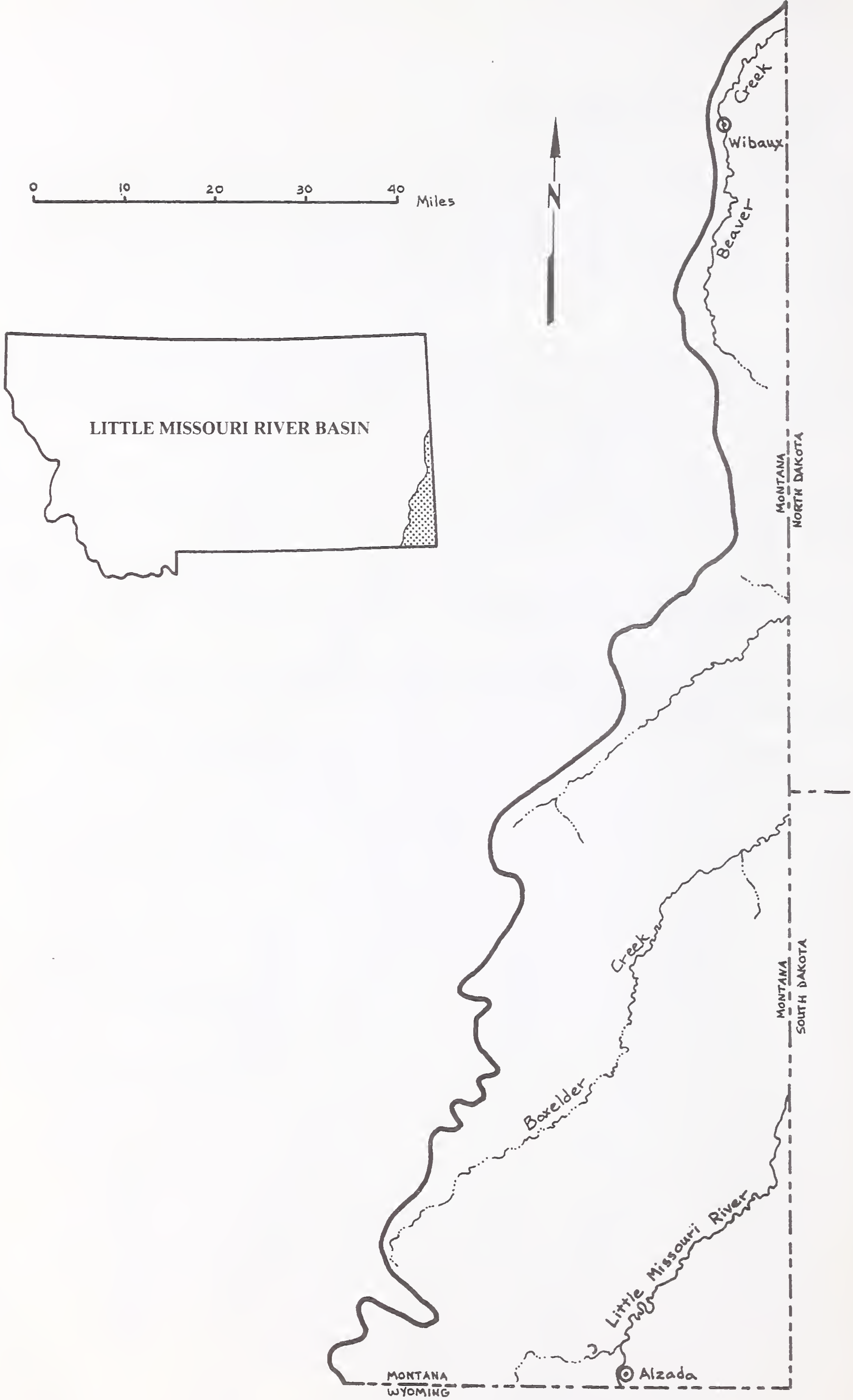
The Little Missouri River Basin covers about 3,360 square miles in extreme southeastern Montana. The basin is an area of rolling hills with gentle to moderate relief. An area of about 11 square miles in the extreme southeast corner of the basin drains into the Belle Fourche River in Wyoming and South Dakota. All of the remaining streams are tributary to the Little Missouri River, which in turn flows into the Missouri River at Lake Sakakawea, North Dakota.

The Little Missouri River Basin has a semi-arid continental climate, with cold dry winters, cool moist springs and warm summers. The average annual precipitation for the area ranges from 11 to 14 inches. Approximately 75 percent of the precipitation falls from April through September.

Most of the basin is used for dryland and irrigated crops and for range. Approximately 80 percent of the area is classified as grazing land. About 182,000 acres are under cultivation with about 42,000 of these acres irrigated. The predominant water use in the basin is for irrigation.

Surface water quality throughout the basin ranges from fair to poor. There is a heavy reliance on groundwater for stock and domestic supplies.

The post-1975 data available to the Water Quality Bureau on STORET indicate that there are no significant pollution problems in this basin that are predominantly man-caused.


0 10 20 30 40 Miles
N
LITTLE MISSOURI RIVER BASIN
Creek
Wibaux
Beaver
MONTANA
NORTH DAKOTA
MONTANA
SOUTH DAKOTA
Creek
Boxelder
Little Missouri River
Alzada
MONTANA
WYOMING

MONTANA
WATER QUALITY
1984

Errata p. 90

MONTANA
WATER
QUALITY

1984

Five hundred copies of this publication were produced at a unit cost of $4.00 per copy for a total of $2,000, which includes $1,850 for printing and $150 for distribution. This is a biennial report required by the Environmental Protection Agency under Section 305(b) of the Federal Water Pollution Control Act.